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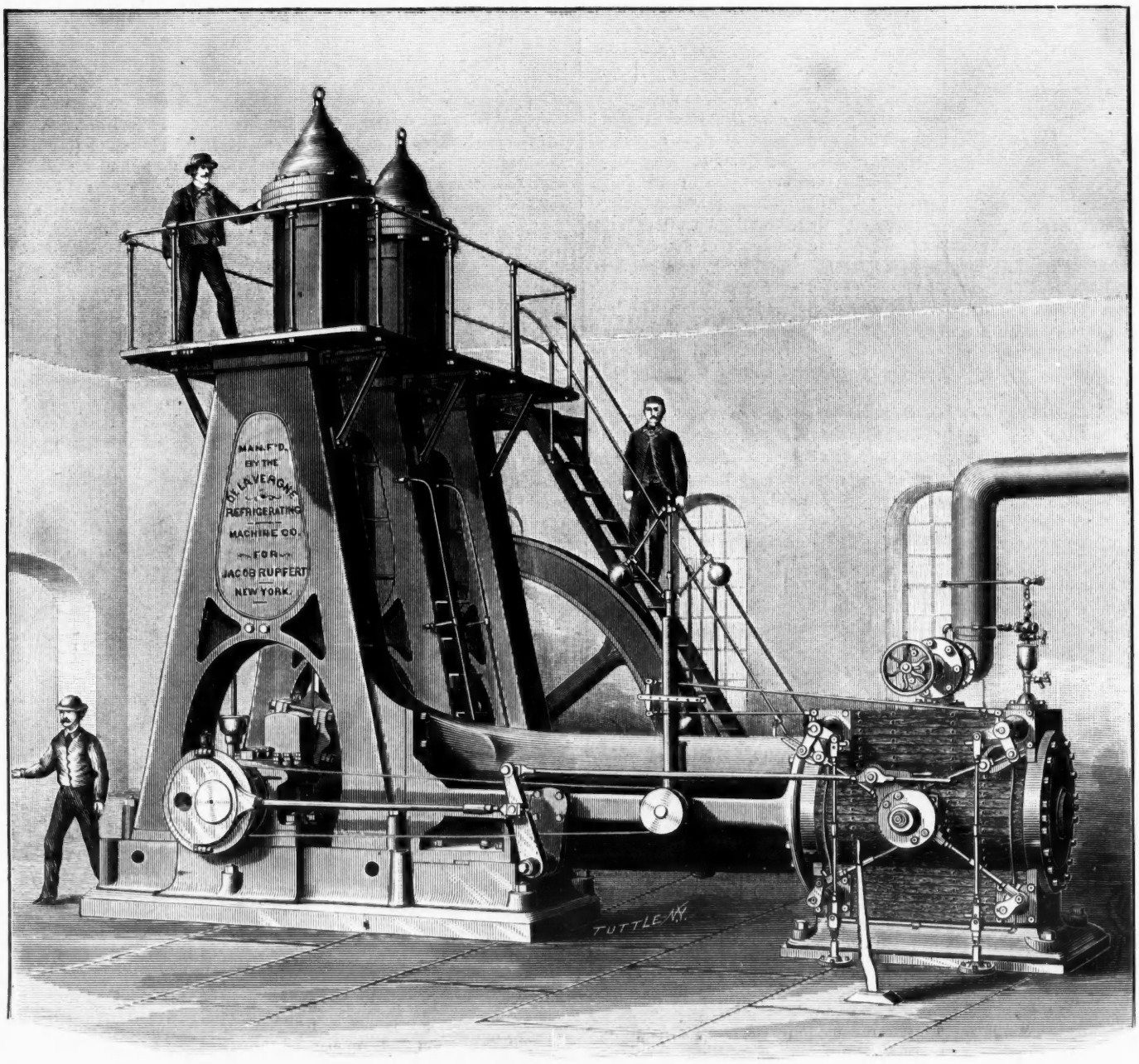
The De La Vergne Refrigerating Machine.

The progress of modern requirements has created the demand for artificial reduction of atmospheric temperature on an extended scale, for the purpose of preserving food and other products that rapidly deteriorate in ordinary summer temperature. In some instances artificial reduction of temperature is to promote personal comfort and health, and the demand in this line is yearly becoming greater. The primitive method of producing artificial reduction of temperature was by storing natural ice in such a way that its melting would cool the surrounding air. This system of artificial cooling may be regarded as equally crude with the style of artificial heating where dwellings were warmed by burning logs on an open hearth. Mechanical science long ago provided improved methods of heating, and various systems seeking that end have been highly developed. The same science is now grappling refrigeration, and before many years we may expect to see the means of cooling buildings as well arranged as are now the appliances for heating.

Mechanical refrigeration dispenses entirely with the use of ice, and produces the required degree of cold by the compression, cooling, and re-expansion of some elastic gas, or by the rotatization and subsequent condensation of a liquid. The equivalence of heat and mechanical energy is well known, and the law was probably discerned by the early workers on mechanical refrigeration. Experiments in this line were made sixty years ago, and the results obtained indicated that mechanical refrigeration might be practical; but in working out the details of the system numerous discouraging difficulties were encountered. As he proceeded to investigate the elements best suited for producing the cooling medium, the mechanical engineer had to obtain the aid of the chemist. Many compounds were tried for the manipulations of refrigeration—atmospheric air, ammonia, ether, petroleum products, bisulphide of carbon, sulphurous dioxide, and others being experimented with. It was early discovered that ammonia, with its low boiling point and high capacity for latent heat, possessed properties that promised to make it an excellent refrigerating medium, if mechanical means could be devised to control it. The contriving of these means has, as intimated, long engaged the attention of engineers, but until comparatively recently the difficulties encountered have prevented the attainment of the measure of success that it was evident ought to be obtained by the process. Grave objections had to be overcome, and overcoming them was the work of time and hard application and study. Air had been tried extensively, but it required extremely heavy machinery for the amount of work done; in fact, carefully conducted experiments demonstrated that it was necessary to compress ten times as much air as ammonia to do the same work. All the other liquids and gases mentioned developed various objectionable features.



THE DE LA VERGNE REFRIGERATING MACHINE.

The machine shown in the engraving was designed specially for ammonia, and is the result of numerous experiments. Experimental machines were made and put in operation, and appliances were devised to remedy weak or defective points as they developed. In this machine the horizontal cylinder is the steam cylinder, which drives a shaft operating the connections of the vertical cylinders on top of the upper platform, which are the gas compressors. By a process invented by Dr. Suckert, all the water is extracted from the ammonia, and the anhydrous compound left is gaseous at ordinary temperature. The extreme tenuity of ammoniacal gas renders it excessively difficult to pump under compression without leakage, and numerous ingenious appliances are used in this machine to prevent waste of gas or power from this cause. To perform the double purpose of preventing leakage through stuffing boxes, and to effect a perfect discharge of the gas, a jet of lubricating liquid is injected into the cylinders of the compressors at each stroke, and part of this lubricant is forced out at the completion of each stroke. The ammoniacal gas is compressed to a tension of 160 pounds to the square inch, and forced through a coil of pipes, over which cold water is constantly running.

When this point is reached the gas is ready to assume the liquid condition, when more heat is given off, and that is also absorbed by the cold water. As the gas passes from the compressor to the cooling coil, the lubricant, which is a product of petroleum that does not saponify by contact with ammonia, is by ingenious means separated from the gas and passed through a cooling coil, from whence it is again pumped into the compressor. After passing through the cooling coil, the liquefied gas is admitted through an air-drawing valve and allowed to expand into the refrigerating pipes used for cooling rooms, packing establishments, breweries, ships, hospitals, or other places where the operation is applied. These pipes are generally ranged around the walls of the apartments. When the gas that has been deprived of its heat passes through these pipes it absorbs the heat from the iron, and the iron in its turn absorbs heat from the air of the room. Having done its cooling work, the ammonia is drawn again into the compressor, and keeps going round the cycle, just as the steam used in an engine with a surface condenser passes its cycle from boiler to cylinder, thence to condenser and back to boiler.

Apartments cooled by this system receive the benefit of having the air thoroughly dried while cooled, so that there is no danger from mildew, which is so often troublesome where ice is used in cooling. The handling of ice and its resulting water is also avoided.

Great mechanical skill and ingenuity have been devoted to perfecting this machine and its connections, and no small share of the credit of the success is due to the able superintendent of the works, Mr. J. E. Wilson,

and to Mr. Louis Block, chief engineer. All pipe joints are made of heavy malleable iron with lead gaskets. The joint connections are screwed upon the thread and soldered, so that they can stand a pressure of 1,000 pounds to the square inch.

Numerous arrangements of coils, valves, cocks, pipes and other parts are admirably carried out to make the machine secure against failure for a single hour. The care and judgment exhibited in proportioning the machine receive creditable testimony in machines that have been running for years without causing any stoppages. Indicator diagrams taken from the compressors show the actual efficiency to be over 99 per cent. of the theoretical efficiency. An ordinary machine of this type for each ton of coal burned performs refrigerating work equal to the melting of 20 tons of ice. This is equal to putting ice into the cooling room at an expense, ranging from 15 to 30 cents per ton according to the cost of coal. When the facts are taken into consideration that it takes 100 pounds of ice to cool and cure a single hog, and 300 pounds to cool a barrel of beer, the importance of machinery that can supply the refrigerating means without the labor attendant on the handling ice will be readily perceived. These machines are made by the De La Vergne Refrigerating Machine Company, Bank street, New York, and the perfection of the machine is in no small measure due to the intelligent persistence in the cause of mechanical refrigeration of John C. De La Vergne, president of the company.

An Engineer's Fatal Neglect.

A telegram with the above heading was sent all over the country recently. The message went on to state that the steam apparatus belonging to a wagon factory in Morton, Ill., was being used in the manufacture of cider, when suddenly the boiler exploded with a terrific force, killing the engineer and several other persons. The cause of the explosion was *supposed* to be that the engineer allowed water in the boilers to get too low, and then filled them up suddenly with cold water. This is a mere theory without any facts to substantiate it, and it is one the boiler *experts* of country towns are very fond of using to explain boiler explosions; yet the conscienceless maligner who prepared the dispatch did not hesitate to bring the charge of criminal carelessness on such flimsy grounds against the engineer, whose self-vindicating tongue was silenced by death. From what we have seen of the average rural boiler, we feel safe in venturing the opinion that, were this case investigated by a competent inspector, the cause of the accident would be found in the boiler having been worn out, and the engineer, who cannot defend himself, is made the scapegoat for some other person's sins; a thing that is quite too commonly done, and that will continue until the causes of boiler explosions receive more attention from those competent to arrive at proper conclusions.

Instruction in Mechanical Engineering.

In the course of instruction in mechanical engineering the writer has incorporated the scheme of a workshop course. This is done, not at all with the idea that a school of mechanical engineering is to be regarded as a "trade school," but that every engineer should have some acquaintance with the tools and the methods of work upon which the success of his own work is so largely dependent. If the mechanical engineer can acquire such knowledge in the more complete course of instruction of the trade school, either before or after his attendance at the technical school, it will be greatly to his advantage. The technical school has, however, a distinct field; and its province is not to be confounded with that of the trade school. The former is devoted to instruction in the theory and practice of a profession which calls for service upon the men from the latter—which makes demand upon a hundred trades—in the prosecution of its designs. The latter teaches, simply, the practical methods of either of the trades subsidiary to the several branches of engineering, with only so much of science as is essential to the intelligent use of the tools and the successful application of the methods of work of the trade taught. The distinction between the two departments of education, both of which are of comparatively modern date, is not always appreciated in the United States, although always observed in those countries of Europe in which technical and trade education have been longest pursued as essential branches of popular instruction. Throughout France and Germany, every large town has its trade schools, in which the trades most generally pursued in the place are systematically taught; and every large city has its technical school, in which the several professions allied to engineering are studied, with special development of those to which the conditions prevailing at the place give most prominence and local importance.

A course of trade instruction, as the writer would organize it, would consist, first, in the teaching of the apprentice the use of the tools of his trade, the nature of its materials, and the construction and operation of the machinery employed in its prosecution. He would next be taught how to shape the simpler geometrical forms in the materials of his trade, getting out a straight prism, a cylinder, a pyramid, or a sphere, of such size and form as may be convenient; getting lines and planes at right angles, or working to miter, practicing the working of his "job" to definite size, and to the forms given by drawings, which drawings should be made by the apprentice himself. When he is able to do good work of this kind, he should attempt larger work, and the construction of parts of structures involving exact fitting and special manipulations. The course, finally, should conclude with exercises in the construction and erection of complete structures and in the making of peculiar details, such as are regarded by the average workman as remarkable *tours de force*. The trade school usually gives instruction in the common school branches of education, and especially in drawing, free-hand and mechanical, carrying them as far as the successful prosecution of the trade requires. The higher mathematics, and advanced courses in physics and chemistry, always taught in schools of engineering, are not taught in the trade school, as a rule; although introduced into those larger schools of this class in which the aim is to train managers and proprietors, as well as workmen. This is done in many European schools.

As is seen above, the course of instruction in mechanical engineering includes some trade education. The engineer is dependent upon the machinist, the founder, the pattern-maker, and other workers at the trades, for the proper construction of the machinery and structures designed by him. He is himself, in so far as he is an engineer, a designer of constructions, not a constructor. He often combines, however, the functions of the engineer, the builder, the manufacturer, and the dealer, in his own person. No man can carry on, successfully, any business in which he is not at home in every detail, and in which he cannot instruct every subordinate, and cannot show every person employed by him precisely what is wanted, and how the desired result can be best attained. The engineer must, therefore, learn, as soon and as thoroughly as possible, enough of the details of every art and trade, subsidiary to his own department of engineering, to enable him to direct, with intelligence and confidence, every operation that contributes to the success of his work. The school of engineering should therefore be so organized that the young engineer may be taught the elements of every trade which is likely to find important application in his professional work. It cannot be expected that time can be given him to make himself an expert workman, or to acquire the special knowledge of details and the thousand and one useful devices which are an important part of the stock in trade of the skilled workman; but he may very quickly learn enough to facilitate his own work greatly, and to enable him to learn still more, with rapidity and ease, during his later professional life. He must also, usually, learn the essential elements and principles of each of several trades, and must study their relations to his work, and the limitations of his methods of design and construction which they always, to a greater or less extent, cause by their own practical or economical limitations. He will find that his designs, his methods of construction, and of fitting up and erecting, must always be planned with an intelligent regard to the exigencies of the shop, as well as to the aspect of the commercial side of every operation. This extension of trade education for the engineer into several trades, instead of its restriction to a single trade, as is the case in the regular trade school, still further limits the range of his instruction in each. With unusual talent for manipulation, he may acquire considerable knowledge of all the subsidiary trades in a wonderfully short space of time, if he is carefully handled by his instructors, who must evidently be experts, each in his own trade. Even the average man who goes into such schools, following his natural bent, may do well in the shop course, under good arrangements as to time and character of instruction. If a man has not a natural inclination for the business, and a natural aptitude for it, he will make a great mistake if he goes into such a school with the hope of doing creditable work, or of later attaining any desirable position in the profession. *Prof. Thurston, in Journal of the Franklin Institute.*

Topography of Machines.

A PAPER READ BEFORE THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, SECTION D, AT PHILADELPHIA, SEPTEMBER 10, 1884.

By Oberlin Smith.

The object of this paper is to briefly call attention to the loose system, or rather entire lack of system, prevailing in our drafting rooms and machine shops, in writing and speaking of the relative locations of the various parts of machines.

In designing and building a new machine, especially if of a new type, numerous verbal explanations are necessary—from designer to draftsman, and from either, or both, to pattern-makers, machinists and other artisans. These may be written or oral, but are usually both. They should, however, in all cases, be of such a character as to be clearly expressed in words alone, without the need of arbitrary signs in writing, or gestures in speaking. Thus in these days, when time is so valuable a commodity, especially with the higher grades of workers, much of it may be saved if a designer can verbally express his ideas without ambiguity—perhaps to a stenographer for record—perhaps, through a telephone, to a distant assistant.

To carry out this matter to an ideal state of perfection would involve a reform in mechanical nomenclature and the coinage of a number of new words, together with the establishment of a system by which any part of a machine could be definitely located, and its entire construction described in a table of words and figures, without the use of any drawings at all. Such a scheme is briefly outlined further on, and its partial application to actual work, but a more important purpose of this paper is to urge a reform in the use of a few words pertaining to location and motion, which are commonly employed by draftsmen and machinists in a very ambiguous way.

An instance of this is where some point on a drawing is spoken of as to the right or left of some other given point or line, because it appears so upon a side view, while, in the machine itself, it is really backward or forward of the given point or line. Another instance is where some member of a machine is supposed to have considerable individuality of its own and has some important side, which its christener chooses to call its front, facing in a different direction from the main front of the machine itself. This is the case in an ordinary lathe, where the main front is toward the operator, and where the front side of the bed or of the carriage, or the front end of the cross-slide screw, are very properly spoken of, yet where the terms "front" and "back" spindles mean, absurdly enough, the left and right spindles respectively. Again, the right end of the line spindle is usually called its front end, while the same term, "front," is applied to the left end of the dead spindle. Numerous other cases might be mentioned that are not less foolish, and are even more liable to cause mistakes, but these will suffice as examples.

The writer, in his own practice, has found the remedy for these evils simple enough by merely establishing the following positive rules: 1st. Every machine must have some one side assumed as its front, and another side, at right angles to this, and the one that is usually beneath, assumed as its bottom. Opposite to these respectively are, of course, the back and the top, while the right and left are at the right and left of a person standing in front of the machine and facing toward it. This applies to stationary machines, and the side assumed as the front should usually be that toward which the operator is habitually placed. 2d. In the case of traveling machines, such as boats, locomotives, reapers and other vehicles, the end that goes forward must, of course, be called the front. As the operator is upon such a machine (instead of outside of it), and with his face forwards, the right and left sides are reversed in relation to the front and back. This would seem to break up the unity of the system, but it need occasion no practical inconvenience if the names of the different sides are definitely fixed upon and distinctly marked upon all the views in the drawings. 3d. In stating the location of any part in relation to some other part, or to a main center line or reference plane, the only terms to be used are these six: "Front of," "back of," "right of," "left of," "above," "below." If the point to be located is in a diagonal direction from its reference point, its place is usually defined by two or more of these rectangular measurements, and not by its diagonal distance. In some cases, however, it is more convenient to give its actual diagonal distance, and otherwise define its position, by angular measurement from a rectangular line drawn through the reference point. Thus the back-gearing spindle, or "quill," of an engine lathe might be located as so many inches from spindle axis, and so many degrees above back, instead of giving the number of inches back and up. The former way is here better (as it is in most cases of geared shaft), because the actual distance is a definite one, being the sum of the radii of two pitch circles. Of course, these shafts can be located by their axes alone, as can all cylindrical, conical and other round bodies or spaces.

The writer has found this accurate use of terms of great advantage in explaining new work to his assistants, and has on a quite recent occasion been enabled thereby to have them hurry to completion an intricate machine, the design of which he was obliged to leave unfinished when starting away for a somewhat prolonged absence. The necessary explanations were sent partly by letter and partly by telephone, and, although the phraseology used, with the frequent "ups," "backs" and "lefts," might not have been the most poetically flowing English, yet it had the merit of meaning exactly what it meant, and nothing else.

The ideal system before referred to is in the same line of thought, but goes much further. The idea is to locate any desired number of points in a given machine upon the same general principle as positions are fixed upon the earth's surface by latitude and longitude, but the directions of measurement would be at right angles to each other, and would be three in number.

In this system all measurements would be taken perpendicularly from three imaginary "reference planes," which would preferably, in most cases, be exterior to the machine, and would, of course, be the three adjacent sides of an inclosing cube. They

could be in any desired position, but would, perhaps, be as convenient as any way if placed at the bottom, left and back. In such case, all measurements would be either "up," "right" or "forward," and could be conveniently abbreviated as "U," "R" and "F," respectively. Thus it is obvious that any desired number of points upon the surface of any member of a machine (or, for that matter, any other object) might be successively located simply by a line or column of figures, representing inches or some other uniform unit of measurement, each prefixed by one of the three letters mentioned above. To avoid writing the letter each time, it (or the word for which it stood) might be placed at the top of a column in which all the figures relating to that "dimension" might be written. Matters could be still more simplified by taking a set of horizontal measurements all at one given height, which might be expressed, once for all, at the top of the column. After these were taken, another set could be made, in a horizontal plane at a distance above the last one, which represented the degree of delicacy required. For defining the shape of a cast-iron frame of a midium-sized machine, for instance, a set of measurements at each inch in its height would usually be sufficient.

The method above outlined would, if followed out strictly, require a ridiculous number of unnecessary measurements if such objects as shafts, pulleys, cog-wheels, etc., were to be defined by points upon their surfaces. Happily, however, the matter could be enormously simplified by locating such members of a machine by their axes and one of their ends only. Such a system would be of extended practical use only by having a machine made up of as many standard shapes as possible, each of which could be individually located in a very few measurements, perhaps in some cases angular, instead of lineal.

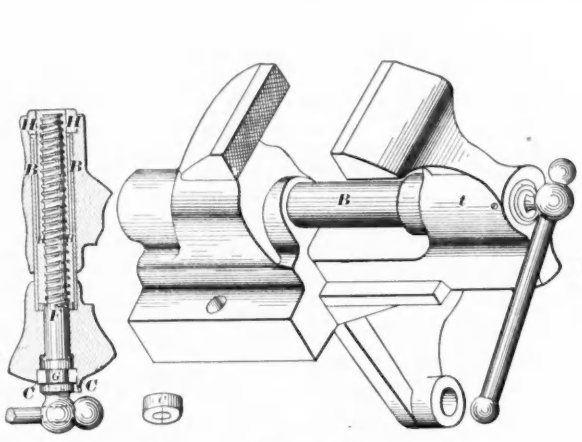
A modification of the proposed exterior reference planes would sometimes be desirable by making two or more of the planes intersect, and one or more of them to lie in some main axis or center line of the machine. This would most likely be the case where symmetry of design would allow a set of measurements to be repeated in an opposite direction. If these were given in detail, it would be necessary to use the words "down," "left" and "back" as well as "up," "right" and forward." These could be expressed as "D," "L" and "B," respectively, unless it should prove better to use only the first given set of letters, and put minus signs in front of them when reverse directions were to be given.

As outlined above, the system is in a very crude condition, but the principle is capable of wide application in practical engineering, as combined with a system of drawings, if not actually supplanting them. The writer has frequently found it very useful in "figuring up" rough sketches and memoranda of an existing machine, which it was desirable to add to, alter or reproduce, and of which drawings had to be made. In such a case, the floor answered as one of the reference planes, while a side and rear wall, or, in lieu thereof, a pair of large drawing-boards, fastened in a vertical position, at right angles to the floor and to each other, answered as the other two planes. For taking the measurement a large "surface gauge" or "scribe block," together with a graduated scale of some sort, fastened, for the time being, perpendicular to the plane from which the distances are being taken, are very convenient tools.

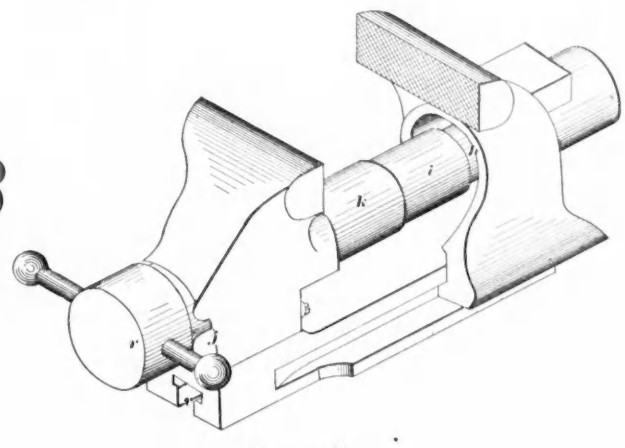
This definite locating of all important parts from common starting places, and independently of each other, will be found vastly more accurate and complete than the method used by many draftsmen where a lot of measurements are taken at random, from some place to any place, and where one is apt to find afterward, when too late for remedy, that some "key-note" in the survey has been left out entirely.

In plotting down such a survey as has just been referred to, it will be found of great benefit to use cross-ruled drawing paper, preferably graduated to inches, and their halves, quarters and eighths, the inch lines being the heaviest. These lines should be numbered from one edge of the paper each way; and their use is just as important as are the lines of latitude and longitude in copying a map drawing.

In conclusion, the writer would say that no new principles are here claimed, but merely the application of some very old ones, and as yet in a somewhat imperfect way, to the ordinary operations of machine-shop practice.



Hepworth Vise.



Backus Vise.

Expiring Vise Patents.

By F. B. Brook, Washington, D. C.

The great majority of American mechanics and manufacturers lose sight of the two-fold nature of the patent laws. They readily understand that the government offers protection for meritorious inventions, but fail to conceive the reciprocal benefits which accrue to manufacturers. An inventor, obtaining a patent, and the United States, enter into a contract, which is mutually advantageous to both parties. In consideration of the people (which is the United States) granting a monopoly to a patentee for a limited period, the patentee agrees to dedicate his inventions or discoveries to the public for the public good. If the patented article be valueless, the contract or patent is precisely similar to an obsolete law, and can, in general, affect no one.

We have undertaken to give herewith descriptions of a few representative vises, the mechanical construction of which is already, or about to become, public property, and consequently the ideas contained therein are free to be appropriated by manufacturers and other interested parties, and to be used freely.

The first design which we will here consider is that granted to S. S. Hepworth, and which became public property on the 11th of April last.

A perspective view, and also a detail sectional view, is here given of the Hepworth vise. The nature of the improvement consists in providing the screw F with a pipe casing B, attached to either the fixed or movable part of the vise; also in attaching the nut A to the vise by means of the collar H, so that the casing B may slide over it when the vise is shut. The screw F differs from the usual form in being provided with the groove G for the reception of the bushing C formed in two parts. The nut A is of elongated form, as shown, having the collar H firmly fitted in a recess at the back end of the vise. This collar is of larger diameter than the rest of the nut, so that the casing can slide as far back as the collar.

When the vise is in use, the casing slides in and out and shields the screw from filings or anything which might interfere with its proper action.

The patent granted John S. Hoar has

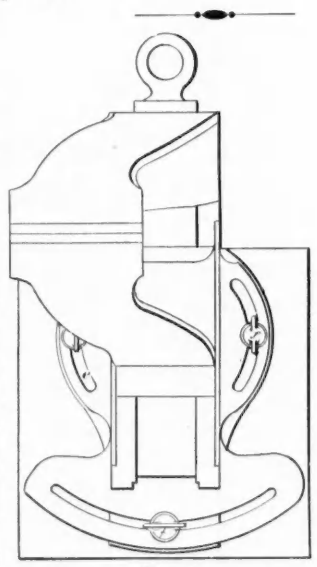


Fig. 1

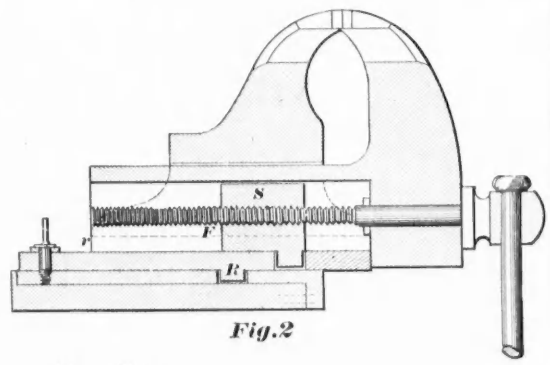
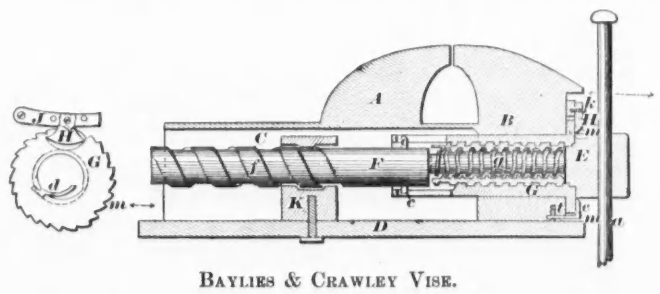


Fig. 2

Hoar Vise.



Baylies & Crawley Vise.

The patent of Q. S. Backus, which will expire June 2, 1885, is of interest as exhibiting a good style of vise, mechanically considered. The only novelty claimed by Backus, however, is the arrangement of the telescopic casing for the protection of the screw shank. In other respects, we believe, the device may be freely appropriated, and also the telescopic protector after the 2d of June next. This sliding tube arrangement is shown in the perspective view here reproduced—h i k represent the three tube sections. When the vise is shut the tubes slide within each other, and when the vise is open they become distended, means being provided so that they cannot be drawn apart.

Messrs. Baylies and Crawley have devised a vise (the patent for which expires the coming September, 1885) having a combination of elements whereby the jaws are rapidly adjusted—that is, more quickly than by the ordinary pitched screw generally used—also, it is said, appling the pressure with greatly increased power. Both operations are performed with one hand by a continuous movement of the same device.

Referring to the illustration of the Baylies and Crawley vise, it will be seen that for adjusting the jaw B the screw E is turned by means of a lever a, the friction of spring d being sufficient to carry sleeve G with screw E. The sleeve G carries with it the bolt F by reason of pins c in the slots in the sleeve. Thus, in adjusting the vise the rabbet screw f only is employed. When clamping an object in the vise, the screw E is turned to the right continuously. The first resistance offered to the jaw overcomes the effective action of the friction spring d, thus stopping sleeve G, and consequently screw f, in which case the turning of screw E causes the latter to recede at the rate of an inch to four revolutions with relation to screw g. The separation of screw E and sleeve G being greater by one-third, the latter is advanced one-third of an inch to each inch traversed by the receding screw E.

The jaw B, being carried by sleeve G, thus produces, it is claimed, a pressure equal to what would be obtained by a screw having twelve threads to the inch. When, by turning screw E in applying the pressure, the boss of the screw is withdrawn from the jaw, the trigger H drops between the shoulder of the boss and allows the pawl J to engage the ratchet teeth on flange m, thereby preventing sleeve G from turning to the left and locking screw f. The pressure of the shoulder of screw E, when it comes in contact with the trigger, lifts it, by which the pawl is disengaged. Screw E, being returned to its former position with the shoulder against flange m, is then prevented from further turning except in conjunction with sleeve G and screw f. The jaw is thus rapidly withdrawn.

played a controlling game during its existence. Originally issued June 19, 1866, it was reissued the following year, with broad claims designed to cover completely any vise having mechanism whereby a horizontally-turning motion was given the bed plate; and also the eccentric arrangement of the jaws with respect to the shank.

The Hoar patent (doubtless familiar to all manufacturers of vises) is shown by both a top and a sectional view. It expired last spring.

The bottom part of the stationary jaw-carrier is a flat plate, carrying three arc-shaped slots revolving on a pivoted center. The shank of the movable jaw is grooved lengthwise in order to receive the screw and the threaded stationary standard in which the former works, and which gives motion to the movable jaw. The object of the peculiar arrangement of the jaws is to enable any long article, when projecting below, to be held by them without interference from the shank, thus affording more scope to the use of the vise than exists when the jaws are arranged in the ordinary manner.

By constructing the stationary jaw-carrier with three slots, the back slot and its screw will serve not only to afford greater stability to the whole vise, but to prevent the metal at the side or shorter slots from being broken when the vise may be in use.

New Mechanics' Society.

A number of machinists and engineers of Brooklyn, N. Y., held a meeting on Tuesday evening, September 23d, and organized the "Kings County Mechanical Association of Practical Engineers and Machinists." The object of the society is for mutual improvement and progress in their business. It is intended to establish a library and reading-room, and also to have lectures on mechanical subjects. A great many machinists and engineers in Brooklyn have wished for the establishment of such a society. They will hold meetings every Tuesday night at 136 Broadway (Heiser's Assembly Rooms). The officers are as follows: James Canning, president; John Scott, vice-president; Walter Scott, secretary; John T. Smith, financial secretary; Henry Roll, treasurer; and Bernard McCafferty, warden. Each member pays $1 initiation, and 50 cents a month for dues.

Harlow's Valve Gear for Direct-Acting Steam Pumps.

In the engraving representing this valve gear the left hand figure is a section through *X X* of the right hand figure. It consists of three parts, viz: The auxiliary valve *P*, attached to the main piston-rod and moving with it, the auxiliary piston *F*, and the main valve *V* moved by the auxiliary piston. Its operation may be described as follows: As represented the main piston has reached the end of its upward stroke, and the auxiliary valve *P*, has opened the ports *B* and *C*, exhausting the steam from the end of the auxiliary piston. Steam enters the other end through the port *D*, and moves the main valve to the other side. When the main valve is open for the return or downward stroke the ports *B* and *D* are covered by the auxiliary piston, the valve remaining in its position. When the main piston reaches the lower end of the cylinder the end of the auxiliary valve *P*, has passed below the ports *A* and *C*, and the auxiliary piston is moved at the other end of the stroke, as previously described, by steam entering through *D'*.

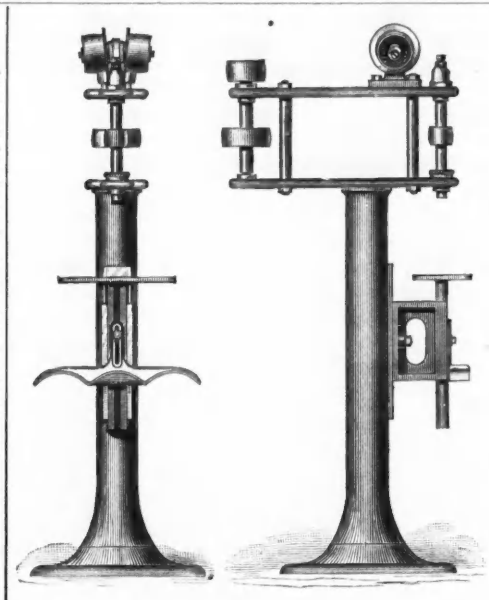
It will be seen that the actuating of the valve is accomplished without the use of tappets, levers or cams of any kind, and that the motion is substantially positive. The auxiliary piston is steam-cushioned to avoid striking the heads, and this also accomplishes another purpose, that is, if the auxiliary piston is moved too far, so as to partially cover the main steam ports, the cushion pressure returns it so as to leave the ports fully open.

The main steam ports, where they enter the cylinder, are divided, so that when the main piston nears the end of its stroke the supply of steam is diminished. Similarly, the full supply of steam is not admitted until after the piston has traveled a short distance on its return stroke. This provides for a slow motion at the beginning and end of the stroke (approximating the motion from a crank and fly-wheel), avoids striking the heads with the piston, and gives the valves time to seat quietly and without shock.

This pump was designed by Mellen S. Harlow, 372 Washington St., Hoboken, N. J.

The old-fashioned spinning wheel is considered by many a thing of the past, but in a recent visit to one of the interior towns of New Hampshire we found their manufacture was a part of the business of one establishment. The demand is mostly from the South.

According to the *Chemiker Zeitung*, a cement very useful for cementing glass to metals is made by boiling one part of caustic soda and three parts of colophony with five parts of water, and kneading up the resin soap thus formed with half its weight of gypsum. This cement is said to withstand considerable heat, and not to be affected by petroleum, and is recommended, amongst other things, for cementing brass burners on kerosene lamps.



One-Spindle Drill.

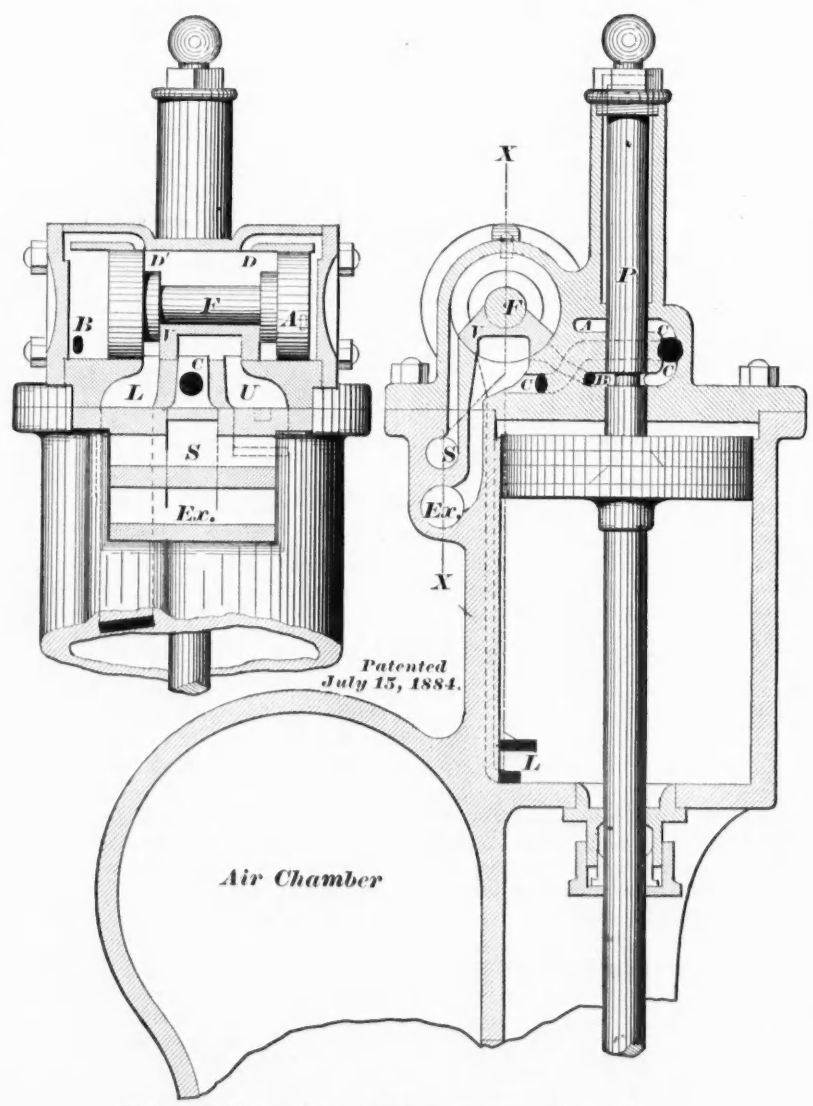
This machine is designed for all kinds of light drilling up to $\frac{3}{8}$ inch. It is operated by knee pressure, leaving the hands entirely free to handle the work to be drilled, which can be done very rapidly.

The machine may be run at a very high rate of speed, and is adapted to the smallest drills.

The boxes are of hard bronze, and are made adjustable to take up wear.

The spindle is fitted for No. 2 Morse taper.

This drill is made by the Hendey Machine Company, Torrington, Conn.



HARLOW'S VALVE GEAR FOR DIRECT-ACTING STEAM PUMPS.

LETTERS FROM PRACTICAL MEN.

Cutting Glass Tubes to Length.

Editor American Machinist:

I cut my glass tubes for water-line gauges as follows: I make a small mark or scratch with a file where I want to cut them. Then I fasten around my waist one end of a piece of strong whip twine, holding the other end fast in the vise. Take the glass and give the twine one turn around it at the place where it is marked, making a guide of hands and thumbs to keep the twine in place. Then I draw my body back to create pressure, and move the glass to and fro. This heats the glass quickly, when, by getting some one to pour a little cold water on it, it is, by a slight effort with the hands, using the thumbs as a fulcrum, readily broken off true.

Adria, Italy. H. FOSTER.

Proportioning Slide Valves.

Editor American Machinist:

It has been shown in former letters, that with an equal lead at each end, and the ordinary valve connections, the cut-off will not be equal at the two ends of the engine; and it has also been stated that the question of lead, when the ports are ample, is more a question of smooth running than anything else. It will be found in many cases that the cut-off can be made very nearly equal by giving the valve more lead at one end of the engine than at the other. The engine may begin to take steam a little before the crank gets to the dead center at one end, and a little after or just on the dead center at the other, and so get several degrees of crank revolution difference at the two ends without showing much distortion of the indicator cards. And when the cut-off takes place near the center of the stroke, the several degrees is all the difference there is occasioned by the angularity of the connecting rod. But when this change is made it will be found that the exhaust and compression are not equal, and this may be improved by either making one port larger than the other, or by making one end of the valve longer—that is, giving the valve more lap at one end than at the other. The result of these changes can be determined by the same style of diagram as has been shown, except in the case of automatic engines where certain undeterminable elements are introduced. Steam pressure on the end of valve stem and unbalanced parts in the governor mechanism often interfere with otherwise well laid plans. It seems to me that having an engine cut off at exactly equal distances at each end is more a matter of taste than profit. If no one can tell whether an automatic engine is doing its best at $\frac{1}{4}$th or $\frac{1}{8}$th cut-off, or a slide valve is doing its best at $\frac{5}{8}$th or $\frac{3}{4}$th cut-off, and as many good engines do all their work with single-acting pistons, it must be difficult to find out the difference between an even $\frac{11}{16}$th or a $\frac{5}{8}$th at one end and a $\frac{3}{4}$th at the other.

One chronic complaint with the ordinary run of slide valves is the wearing of the seat concave and the valve rounding. This is due to three causes: The wearing surface of the valve being shorter than the seat, the springing of the valve, and the tilting tendency of the valve rod. On general principles, valves would be a great deal better if they were a great deal stiffer, so that the steam pressure would not spring them down into the exhaust port. So far as possible they should be stiffer or stronger (though the former is the better word) without being made heavier, as weight is objectionable. A proper system of ribs on the back, when possible, is the better way. Properly proportioned as to strength and wearing surface, a plain slide valve, if kept from cutting, should wear practically flat, and can be made to do so very nearly, though, to prevent steam-cutting, all the corners of ports and recess in valve should be rounded instead of being made square. The valve rod should take hold of the valve as close down to the valve face as possible. While the tendency to tilt the valve may not be enough to raise the back end, it always increases the pressure at the front, and tends to wear the valve rounding. JOHN E. SWEET.

Locomotive Traction Formula.

Editor American Machinist:

Referring to Mr. Forsyth's letter in the AMERICAN MACHINIST Sept. 20th, relative to the tractive power of locomotives, I cannot conceive how πP^2 equals $\frac{1}{2} d^2 \pi$. Let the diameter d=17 then r=$\frac{1}{2} d$ or 8.5 in. Now $(r^2 \pi)$=226.98 sqr. in. and $(\frac{1}{2} d^2 \pi)$ = 453.96 square inches, and πr^2 being equal to $(\frac{1}{2} d^2 \pi)$ we then have 226.98=453.96, which is impossible. Again, because there are two cylinders on the locomotive, whose pistons make each one double stroke for one revolution of the driver, then instead of 2 L we have 4 L; L being, as before, the length of stroke.

Now $\pi r^2 = (\frac{1}{2}d)^2\pi = d^2\frac{\pi}{4}$ and by substituting the values $d^2 \frac{\pi}{4}$ and 4 L in the equation we have $T = \frac{\frac{d^2\pi}{4} p .4 L}{D \pi} = \frac{d^2 p L}{D}$. This, I believe, is the correct solution, the result being the same as that deduced by Pambour. A formula for tractive force very generally used in practice is

$$\left\{\frac{\frac{d^2\pi}{4} p R^2 6366}{\frac{1}{2} D}\right\} 2 = \frac{\frac{d^2\pi}{4} p R 1.2732}{\frac{1}{2} D}$$

R being equal to radius of crank, D=diameter of driver, and P equal to effective mean pressure on the piston. The results of these two formulas are alike, as previously shown by Mr. Angus Sinclair in his paper in the AMERICAN MACHINIST of August 16th, on traction. T. R. B.

St. Louis.

Machine Shop Floors.

Editor American Machinist:

I see one of your correspondents wishes to know how to make a good ground floor for a machine shop. The Brown & Sharpe Manufacturing Company's basement floors are constructed in the following manner:

The ground is leveled off and *well puddled* and leveled again, then covered with Newark Cement four inches thick, mixed in the following proportions:

1 bbl. best Newark Cement,
1 " fine gravel, or coarse, sharp sand,
3 " coarse stone and gravel (stones from $\frac{1}{4}$" dia. to the size of hens' eggs.

The above thoroughly mixed when dry; water is then added, and the mixture laid and thoroughly floated over to bring the surface to a true level. This is given one week to set. Then 2-inch chestnut planks, planed on one side and edges, are laid in hot coal tar, planed side up, at an angle of 45° with front of building, then floored over with 1$\frac{1}{4}$" planed yellow pine, laid parallel

with front of building, nailed firmly to planking. This makes a floor perfectly solid. Cement keeps back moisture; $3\frac{1}{4}''$ woodwork protects cement, and is sufficient for fastening machinery. Brown & Sharpe Manufacturing Company have about 25,000 square feet of this flooring laid, 15,000 square feet of which have been laid about 13 years and have never given any trouble.

S * * * *.

Locomotive Traction Formula.

Editor American Machinist:

Mr. Forsyth, in the traction, formula uses for value of area of piston $\frac{1}{2}\pi d^2$ instead of $\frac{1}{4}\pi d^2$ and makes his work cancel out the right answer by figuring on only one cylinder. Here is the correct way:

$$T = \frac{\frac{1}{4}\pi d^2 \times P \times 2L \times 2}{\pi D} = \frac{d^2 P L}{D}$$

J. N. Sanborn.

Marshall, Texas.

Advantages of Exhaust Nozzles.

Editor American Machinist:

Will some of your readers have the kindness to point out the advantages claimed (if any) for the exhaust nozzles used by the Pennsylvania Railroad Company, which are rectangular in form?

Will Prof. John E. Sweet show a valve diagram for the following locomotive valve: travel 5″, lap 1″, lead $\frac{1}{16}''$; at how many hundredths of the stroke will cut-off take place? Also the same valve for mid-gear cut-off; travel of valve in mid-gear $2\frac{5}{8}''$, mid-gear lead or port opening $\frac{3}{8}''$?

Ralph E. State.

Lima, O.

Attachment for Shaping Gear Teeth Patterns.

Editor American Machinist:

A few weeks ago, having occasion to make a pair of gear patterns in haste, and, as the pattern-makers were all busy on work that could not be laid aside, we were somewhat at a loss as to how to get them made. Mr. McChestney, the noted band sawyer, better known as the Mohawk Dutchman, who was staying here awaiting the opening of the Exposition, suggested we give him the form of tooth and he would make an attachment for the band saw, so that the boy could shape the teeth and finish the pattern. The plan proved a success, and the patterns were finished in good time. For want of time, I am obliged to send you a very crude sketch intended to give you some idea of the attachment, as I find myself inadequate to describe it intelligibly.

A is the saw table; *B* and *C* are two pieces of board planed true; *D* is the pattern resting on *C*, and held in position by four small blocks *E*, screwed to *C*, but must not bind the gear too tight. At *F* a pin of iron or wood is inserted in *C*, exactly in the center of curve forming sides of teeth; *B* is clamped to the table, and has a hole for the reception of this pin, allowing *C* to swing, thus bringing the pattern to the saw and forming the sides of the teeth.

It will evidently be seen that in forming epicycloidal teeth it is necessary to swing from two centers, while for involute only one center is necessary. The first two teeth require laying off, after which an index pin is inserted in *C*.

This method was new to me, and I thought it might interest some of your readers.

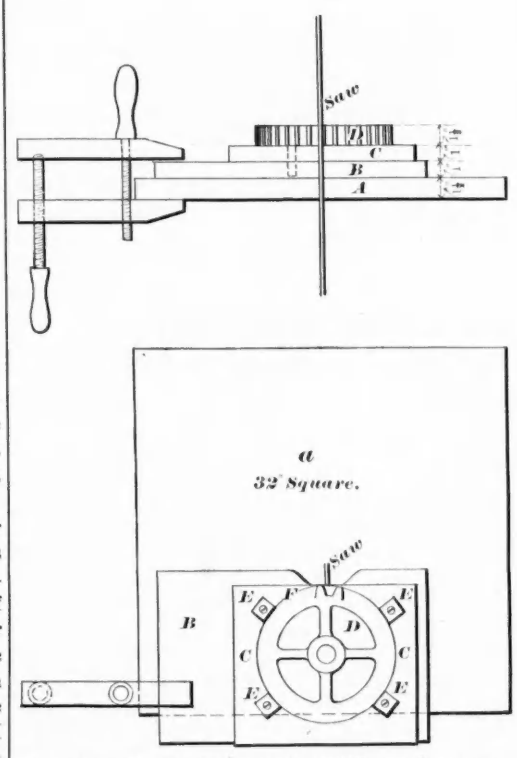
Ed. Judd,
Foreman Hall & Brown, St. Louis, Mo.

Steam engines of small capacity are usually non-condensing, but a small "domestic motor," made as small as one-quarter horse-power, by Hathorn, Davy & Co., Leeds, England, is condensing, being furnished with a condenser and air pump. The engine is run with steam at atmospheric pressure.

"The American System of Electric Lighting" is the title of a pamphlet published by the American Electric and Illuminating Company of Boston. The pamphlet is published in the interest of the company, which controls the Thomson-Houston electric patents, but it also gives interesting information relating to the history and progress of various branches of electrical science. The pamphlet is sold for 25 cents.

William Munzer.

On Sunday, September 14, William Munzer, steam engine builder, 204 East 43d Street, New York, died of typhoid fever, after a few days' illness, in the forty-first year of his age. Mr. Munzer, who was thus cut off in the flower of his manhood, was born in Germany, but was brought to this country thirty-five years ago by his parents, who settled in Newark, N. J. After passing through the ordinary course of day-school education common to youths who are expected to earn their own living before they reach manhood, William entered the works of Watts, Campbell & Co., where he served his apprenticeship as a machinist. For several years after learning his trade he worked in different shops, mostly in New England, intent on seeing how work was done in all kinds of machine shops. The first work he did in New York was at Moller's sugar works, where he obtained the position of engineer, and eventually had charge of all the machinery. In 1872 he started business for himself at the corner of 29th Street and 1st Avenue, where he worked gradually towards engine building. Here he built the first dynamo machine used by Fuller in his electric lighting experiments. By turning out good, faithful work, he soon made an excellent reputation for his shop, which enabled him to go into engine building. Only a few months ago his increasing business induced Mr. Munzer to move into the extensive building now occupied by his shop, and he was fitting it up with the best tools for facilitating the production of exact work. He was a genial, pleasant friend and companion, and his intercourse was valued by a wide circle. In business he was known as an excellent mechanic and enterprising manufacturer.



Attachment for Shaping Gear Wheel Patterns.

Notes of Philadelphia Electrical Exhibition.

Two weeks made a very great improvement in the appearance of this exhibition after the opening day. Everything is now running smoothly, and with two or three exceptions the arrangement of the exhibits is completed. When all the spaces are filled up it gives the visitor an impression that the place is smaller than it seemed to be at first, but the attraction of the display is very marked. Among exhibitions that kept with any degree of strictness to a special line, this is the most interesting we have ever seen. There are a few exhibits whose connection with electrical science is extremely remote, but cases of this kind are exceedingly rare, and we do not believe there ever was a large exhibition held that kept so strictly to its own line as this one.

The machinist or mechanical engineer visiting the exhibition, after going the round of the engines and admiring the numerous perfect products of the machinist's art, is likely to be attracted to the electric motors. There are enough of those to gratify even the most famishing curiosity. With the exception of the dynamos for lighting purposes, which are driven by steam and gas engines, all the machinery in motion in the building is driven by electric motors. The Wm. Sellers & Co. exhibit of machinery, consisting of a lathe, planer, drill press, vertical water pump, and two ventilator fans, are driven by a Weston dynamo. Of course, it is unnecessary to say that the speed maintained is very steady, but the motor was not subjected to the trying ordeal of having heavy work thrown on and off suddenly. The Wicaco Screw Company, of Philadelphia, have seven screw-cutting machines of different sizes at work turning out screws. They are driven by a Van De Poele dynamo, which belongs to a system of electric lighting that this exhibition appears to have brought into prominence. With the exception of a brick-making machine which was at work in the annex, the machine tools were the largest machines driven by dynamos, but the gradations downward were very numerous. Among the lighter machines driven in this way we observed looms that were kept weaving cloth; fans, forges, emery wheels, and sewing machines, of all sorts and sizes. This display of small electric motors suitable for light industrial purposes has, no doubt, attracted the attention of many persons to their convenience where light power is needed. From the conversations heard among several mechanical men interested in manufacturing pursuits, we are disposed to think the public demand for motors of this kind will be cultivated by a fertile supply. Should it come round in a few years that electric motors are as common in households as sewing machines now are, it will be another of the many cases where supply created the demand.

To the electrician we should think an extremely interesting part of the exhibition would be what we might call the museum or curiosity shop, where curious antique and primitive electrical appliances are stored. Here, in an honored place, is the electrical machine constructed by Franklin, and hundreds of devices that bear eloquent testimony to the vast amount of fruitless labor devoted to electricity—patient, ingenious labor that prepared the ground for those who have reaped the harvest of success. The curiosity shop is interesting, but it might have been made immeasurably more so if the machines and instruments had been arranged according to the purpose they were meant for, and in something like chronological order.

In the same room we find the interesting exhibit of Pratt & Whitney, in charge of Mr. G. M. Bond, who shows great patience and infinite good nature in explaining the working of his instruments of precision and exact measurement, so that the dullest comprehension can understand their value and the immense difficulty overcome in perfecting the machines. The Rogers-Bond comparator is here, and, along with the gauges, attracts much attention among engineers interested in the methods of exact measurement that are doing so much to maintain and popularize standard sizes. There is a full set of the firm's gauges, taps and dies, and reamers, and some beautiful drop forgings in this collection. Among the reamers is one of a new style, which is made entirely by specially designed machinery. This reamer is tapering, $\frac{1}{16}''$ to the foot, and is so made that each tooth has the same degree of clearance, thus bringing the cutting edges of every tooth alike in contact with the work. The clearance is very minute, but as each tooth does its share of the work, the reamer operates rapidly and with a minimum expenditure of power. Reamers of this kind are in use that have reamed out 10,000 holes, and are still in good cutting order, without showing a perceptible diminution of size. In this collection there is a fine set of pipe standard taps and gauges. Pipe fittings have for years been made to approximations of standard sizes, and there is an impression that exact sizes are well maintained in this department of mechanical business. Those who look beneath the surface, however, know that pipe sizes were worthy of admiration for their exactness only when other screw threads and rod sizes were in deplorable confusion. Of late years the work of bringing other threads and sizes to exact standards has advanced rapidly, and now pipe fitting which remained stationary is falling sadly behind. There is talk of a convention of iron pipe makers for the purpose of establishing exact sizes in pipe fittings, and it cannot be held too soon. Although the Pratt & Whitney collection is more mechanical than electrical, there is one electrical curiosity about it. On the Rogers-Bond comparator there are two electric incandescent lamps one inch long, used for lighting the microscope. We did not see lamps equally diminutive in any other part of the building.

Letter from a Practical Woman.

Editor American Machinist:

Much has been written regarding proper employment for women. Silk culture, poultry raising and many other themes have been well ventilated, and the result has, no doubt, been very successful. But there are many ladies who cannot raise silk worms, or follow employment of that kind. To this class I wish to introduce what to me was an entirely new field. Some three months since my uncle, from Albany, N. Y., was visiting us. We were talking of plated ware, in the manufacture of which he is engaged, and to gratify my curiosity he made a plating machine, and replated our knives, forks, spoons and caster. The machine cost only $4, and did the work perfectly. Some of our neighbors saw what we had plated, and asked me to do some plating for them. I have since worked twenty-two days, and cleared $94.45. At almost every house I got from $2 to $3 worth of plating to do, and such work is most all profit. This work is as nice for ladies as for gentlemen, and any one can do it. I am making a cabinet of geological specimens, and, to any of your readers that will send me a piece of ore, stones, shells or old coins, I will send complete directions for making a plating machine that will plate gold, silver and nickel. Please address,

Miss Frances Cassey,
Oberlin, Ohio.

How the Fire was Prevented.

Little Ike Shaumburg prevented his father's store from being burned down the other day. He said to the school teacher:

"I am not coming to school to-morrow."

"Why not, Ike?"

"Because we are going to have a fire in our house to-morrow. I heard pa tell ma so last night."

When Ike went home he told his father about the conversation with the teacher, and, although most of the goods had been moved out of the store and the stock was insured for twice its value, the conflagration has not yet taken place. Little Ike, however, has not found it any too cold.—*Texas Siftings.*

On Friday, September 26, one of the best-known engineers in this country, Isaac Newton, during an attack of insanity, committed suicide. Mr. Newton was born in 1838. He assisted Captain Ericsson in designing and constructing the original ironclad monitor, and went with her as first engineer when she sailed down to meet the Merrimac. Since the war Mr. Newton has frequently been engaged as practical and constructing engineer in many large undertakings. He was for 10 years consulting engineer of an extensive coal and iron mining company of Pennsylvania. He was engineer of the Croton Aqueduct at the time of his death.

Relative Strength of Drilled and Punched Sheets.

The annexed cut is the reproduction of photographs taken by Hoopes & Townsend, Philadelphia, of iron plates that had been tested to breaking to show the relative value of drilling and punching. The tests thus graphically recorded are not isolated ones, but are ordinary specimens selected from the results of extended, carefully-conducted experiments. This firm has excellent arrangements for testing the strength of articles they produce, and they have devoted great attention to finding out for themselves how much strain can safely be carried by bars, bolts, rivets, nuts, and other articles of their manufacture. In the course of their testing experiments, they discovered that, contrary to the figures given in all mechanical text-books, punching a sheet does not weaken it so much as drilling holes of the same size. An examination of the figures recorded on the tests shown in the cut will establish the fact that one punched sheet stood over 12 per cent. more strain than that which was drilled, while the other punched sheet stood more than 15 per cent. over what was required to break the drilled sheet.

Early Engineering Reminiscences.

By George Escol Sellers.

SIXTH PAPER.

I now propose to give some of my personal recollections of two extraordinary early American inventors: the first world-wide known as the originator of the steam gun and many other well-known useful inventions—Jacob Perkins, who was born in Newburyport, Mass., July 9th, 1766, and died in London, July 30, 1849. The second was little known as an inventor or a man, as he was, of truly original thought; but, when his total blindness and other surroundings are considered, in my estimation he was the more remarkable man of the two. No doubt there are yet living in Philadelphia those who recollect "blind Hawkins," but there are comparatively few who were familiar with his mechanical idiosyncrasies, of which I shall speak further along.

My earliest recollection of Jacob Perkins was as associated with Murry, Fairman, Draper, Underwood, etc., as bank-note engravers. I think my father's acquaintance dated back of that, as I have heard him relate having been summoned as an expert in a suit for infringement of Perkins' tack machine for cutting and heading tacks in one operation, the ground of the defence being so imperfect a specification that no one could construct a machine from it. After my father had answered that he had neither seen the machine nor read the specification, the latter was handed to him. After he had carefully read it, he was asked if he could construct a machine from it. His answer was, "Yes." He was then asked to explain how he would proceed to do so. The deficiency in the specification was the want of describing the mode of transferring the cut tack to the heading tool. When my father came to that part, he went on describing how he should construct it, and its operation. When asked if he found that portion in the specification, his answer was, "No; but it would naturally suggest itself to any mechanic as the simplest mode; in fact, there were only two ways of accomplishing it." He then described the other mode that would answer the purpose, but it was not so simple and effective. Two machines then in the court were uncovered in which both plans had been adopted—the first described in the original Perkins' machine, the other in the infringing one. This testimony decided the sufficiency of the specification, and the Perkins company gained their suit. I think this was previous to Perkins coming to Philadelphia, and that an intimacy was at that time established.

Perkins had perfected the most important work or invention of his life—the annealing of cast steel, so as to substitute it for copper-plate engraving, and rehardening the plates, transferring to soft steel rollers or dies, from which, after hardening, plates could be multiplied. This manipulation, together with the beautiful scroll-work of Spencer's ingenious geometrical lathe or rose engine, became, and still continues, one of the most important features of our American bank-notes.

While Perkins was engaged in the bank-note engraving business in Philadelphia, he exhibited to my father drawings of his single-chamber fire-engine, with combined plunger and piston, the plunger filling just one-half the area or space of the chamber. As the piston rises, the water, flowing in, fills the entire space of the chamber below it. On being depressed, the lower valve closing, all the water passes through valves in the piston, and, as the plunger fills just half the space, one-half the water is ejected from the nozzle, equal amounts being ejected on both rising and descending strokes. In its simplicity of construction, as arranged by Mr. Perkins, lay all its merits.

He estimated that it could be constructed at a cost of fully 25 per cent. less than the common double-chamber engine. The plunger, the chamber, the surrounding cylinder that carried the water from its escape holes in the top of the chamber to the bottom of the surrounding air vessel, and the air vessel itself, were all to be made of *drawn copper tubes* or cylinders, and clamped between brass bottom and head-plates by outside bolts, the same elongated bolts securing it to the bottom of the wooden engine-box or tub; he also showed the plan of a machine he had devised, and fully tested, for drawing, or rather forcing, these copper tubes or cylinders through dies.

At that time, owing to the smallness of the mains—in fact, all the street pipes were disproportionate to the number of hydrants—the city was very inadequately supplied with water. Good housewives, at night, when the hydrants would run, filled their tubs and buckets for the next day's supply. Almost every square had its street cistern and pump, around which, of evenings, hosts of men, women, and children would collect, waiting their turn to fill their buckets or garden watering-pots (Philadelphia was always a city of grass plats and small gardens); and Mr. Perkins argued that a cheap garden engine, that could be run to these cistern pumps like a wheelbarrow, would have rapid sale. He planned an oval upright tub on two wheels, with wheelbarrow handles and legs, with one of his small single-chamber pumps in it. To build these and small village fire engines, my father joined him under the firm name of Perkins & Sellers. They located their works at the head of St. James', a little court or street that ran east from Seventh above Market Street. This was the germ from which sprang more important works. I will, *en passant*, state that on my father's retirement his place was taken by Dr. Thomas P. Jones, who afterward became Commissioner of Patents, if I recollect right, succeeding Col. Thornton. The business for a short time was conducted under the name of Perkins & Jones, when Perkins decided on going to England. Sam'l V. Merrick, at that time a dry goods merchant, bought his interest, as well as that of Dr. Jones, and associated with him a Mr. Agnew, under the firm of Merrick & Agnew, so long and well known as successful fire engine builders.

It was in these shops, during Mr. Perkins' connection with them, that I learned the peculiar traits of this remarkable man, and which I can no better exemplify than by relating some incidents that therein occurred. From the yard of the house in which we then lived there were gateways into the yard of the shops, giving free access to the works as long as they were carried on. Perkins' original idea, as carried out, was to build a large number of these garden engines before offering them for sale. For this purpose, shops for carpenters, wheelwrights, blacksmiths, finishing, and setting up were started, and as the engines were finished they were stored away, and when first offered the novelty as playthings for the boys caused a rapid sale for a short time; but it was a case where

"The best laid schemes o' mice an' men
Gang aft agley."

For, while these engines were building, the city authorities were relaying their water mains and pipes with cast iron of full capacity, and a screw nozzle to the hydrant and a garden hose became the successful rival of the Perkins' garden engine, and a large portion of the stock on hand had to find a slow sale in suburban villages or country seats.

The Perkins machine for drawing the copper tubes was simple, crude, and ingenious. For the small engines their length did not exceed 12″, the diameter varying 2″ to 10″. The sheet copper was shaped and brazed in the usual way; it was then slid on a mandrel, which, for the small sizes was solid, for the large hollow, with one end closed for the plunger to press against. The enlarged collar for the tube to be pushed by was less in diameter than the die, so that it could pass through it. The press was a simple toggle joint. The leaf of the toggle next the plunger or push end was elongated beyond the center joint as a hand lever. By this lever one man could raise the center joint and work the toggle sufficiently to give a thrust that would force the tubes of 3″ or less in diameter through the die about 1″ at each rise and fall of his pump handle lever; but on larger sizes the toggle required to be worked at a less acute angle, and it took two men to force the 10″ tubes through the die from a $\frac{1}{4}$″ to $\frac{3}{8}$″ at each stroke. As the handle was raised and the plunger drawn back, a suspended wedge would by its own gravity fall and fill the space, ready for the next thrust. These wedges were of a size that when they had fallen their length they would occupy a space of about 5″. They were then raised and blocks dropped in, and so on until the pipe was passed through the die, and came out beautifully smooth and planished.

There was a frequent visitor to the shops who would stand for hours watching this operation often repeating aloud, "The power of the toggle is amazing; if we could only apply it to the ship's capstan it would be grand." This man was Commodore Barron, then in charge of the Philadelphia Navy Yard. He was fond of mechanics, though not grounded in first principles; would be and fancied himself an inventor. Before relating what grew out of his watching the operation of the toggle, I cannot better show Perkins' quickness and some of his peculiarities than by relating what I witnessed with Barron's latest invention, his ship pump. He talked a great deal very mysteriously of it, never explaining, but always promising to bring one he was then having made at the Navy Yard, as soon as perfected, and exhibit its great effectiveness. The day at last came that the Commodore with his pump on a dray made his appearance. It proved to be a flapper piston, working in about a $\frac{1}{4}$ section of a cylinder; he called it his wing piston. This had a valve on it with one below, as in the common lifting pump. This flapper or piston, was worked by a handle on the end of its axis, that came out of the chamber through a stuffing-box; in fact, it was a single acting section of the old Rowntree fire-engine. The misfortune of the Commodore was the lack of published records accessible to him, and no doubt the invention was original with him. He could not have known that he had been anticipated. The pump was put in the cistern, and the Commodore himself worked it, expatiating largely on the volume of water delivered, the flapper being large in proportion to the suction and ejection pipes, and the lift of water not over four feet, consequently the pump worked lightly. Perkins bustled around in his quick way, often taking hold of the handle and working it, repeating, "It works well, Commodore; it is a capital thing." Had he stopped there the Commodore would have gone away delighted, but Perkins, like some other great men, always had a story ready for illustration on every occasion, and was often his own hero. This time he could not keep it in; he began: "Plank, good plank, a side or two of leather, plenty of spikes, nails and rivets, and you always have at command pumps, safety pumps. Why, once I was going from ——— to ——— on a heavily laden schooner, in a storm. She sprung a leak; the water gained on the pumps; it was evident she could not float over an hour. Water-logged as we were it would take several hours to make the nearest port with favorable winds. I took the matter in hand. All I had to work with was a couple of planks 1½″ thick, 9″ or 10″ wide, and one plank 12″ wide, all over 9′ or 10′ long. I set the carpenter to ripping the 12″ plank into two. While he was doing this and spiking them together into a 6″ square spout and squaring them to a length, I was making a bottom board to nail on the lower end. I made a hole through its center 3″ square, put on it a leather flapper, hinged wooden-valve weighted with a bent bar of lead nailed on it. I cut the blade off a sculling oar, and to the lower end of its handle I nailed a conical leather bucket, made out of a couple of boot tops. The bucket was square, to keep it from crushing down with the weight of the water. I had straps from its top nailed to the oar handle through its upper end. I bored holes at right angles, drove through them a couple of deck broom-handles so that four men at a time could take hold. I cut a square hole in the deck sounded the depth of the hole, nailed a strip on the side of my extempore pump to rest on the bottom, secured the top with nails to the deck, and caulked around it with oakum. There was over 5 feet of water in my pump, so the bucket was deep in it. Four men seized the handles and lifted each lift about 2 feet; they averaged fully 50 lifts per minute, each lift spewing on the deck a column of water 6 inches square by 2 feet, which ran off through the scupper holes. We rapidly gained on the leak, and made port, saving the vessel and cargo."

While Perkins was telling this, in his quick, enthusiastic manner, he became more and more excited, and concluded by turning to Barron and saying: "I will bet you an oyster supper for a dozen that I can myself make in less than half an hour a pump that will with one man throw more water than that pump of yours does." The Commodore very good humoredly said he would take the bet, and insisted on an immediate trial. Perkins went into the office, and in a few

minutes returned, coat off, and an old boot in his hand, and said he was ready. (I presume he had been looking up materials and placing them handy.) The company of lookers on, who by that time had increased to a dozen or more, adjourned to the shop, many with watch in hand. Perkins gave the signal when ready to start. His first operation was with his pocket knife, to cut a section of about 6 inches off the top of the boot leg, then another of about 3 inches. These he threw into a bucket of water, while his eye wandered as if hunting materials; then rapidly turning over some strips of inch boards standing in the corner, he selected four of them, two of them 3 inches wide, no two of the same length. He was but a few minutes nailing them into a 3-inch square spout, and sawing off its ends square, closing the lower end with a block, through which he bored a 2-inch hole. He doubled the strip of leather for valve fan and hinge (wooden valve), weighted it by boring a hole through it and putting in a ½-inch bolt that lay on the carpenter's bench. Then to a sweeping-brush handle he crimped in and wired his boot-leg section, roughly squaring its upper end with hammer, tacked with copper tacks, clinching their sustaining straps from the handle. While this was doing the cock was open and the cistern was filling with water. The pump was put in at such an angle as to bring the upper end outside of the low curb; the crudely-made boot-leg bucket was some two or three feet under water. It was just twenty-four minutes after Perkins stuck his knife into the old boot-leg that he had the water pouring over his legs and feet from his extemporized pump. The Commodore declined going into test of quantity pumped, acknowledged himself beaten, said the supper should be at Rubican's; that Perkins should name the time and invite the guests.

Out of little things do great ones grow is true, and it is always interesting to trace their course. Among the lookers on at this trial were two of father's friends, who happened in, Josiah White and Erskine Hazzard, who at that time were engaged in their effort to float anthracite coal down the Lehigh aud Delaware in small barges. Mr. White was so well pleased with the plan of these box pumps with leather buckets, that he adopted them for their barges, from which they found their way to the flat boats of the Susquehanna, and finally to the Ohio river, and the Mississippi and its tributaries, and now there is not a coal barge or shell that descends the Ohio with its millions of tons of coal, or a flat boat carrying millions worth of produce from all the tributaries of the mighty "Father of Waters" that has not two or more of these simple box pumps, worked by spring poles and man power, and on which the safety of its cargo depends, and the leather buckets, or suckers as they are technically called in the West, are to be found ready made for sale in all the supply stores on the rivers. It is just that Perkins should have the full credit of the invention, for small as it appeared at first, it has proved of great utility and vast importance.

Up to this point the Commodore had taken his defeat good humoredly, remarking "that the United States can have any number of my safety pumps on all their vessels, but they cannot find a Jacob Perkins for every man of war." This was the kind of flattery that Perkins liked and never forgot, and he referred to this when I saw him in London in 1832. As the Commodore was having his pump placed on a dray to return it to the Navy Yard, a couple of men came up the court; one remarked to the other, "That is the biggest beer pump I ever saw; it is a whopper." The Commodore hearing this asked the man what he meant; if he thought it would answer to pump beer from one vat into another. The man, who was foreman of a brewery near by, replied that he meant just what he had said, and if the gentleman would wait a few minutes he would show him. He left and soon returned, carrying an English wing beer pump, such as had been used in England time out of mind for pumping beer from the barrel into the glasses or mugs. This was too much for the Commodore; to think that his great pump that he had spent so much thought and labor on, should have been in common use for probably more that a century for such an ignoble purpose, and that he should not have known it. Father tried to satisfy him that his credit for the invention was as great as if he had not been anticipated, as he did not know of it; that the invention had so long stood the test of use should encourage him; that with him invention was not a necessity but a pleasure, and that he should persevere, but advised him when any new idea occurred to him to use every endeavor to learn what had been done in the same direction.

Chill for Castings.

Manufacturers are constantly striving to reduce the cost of production in their goods. To aid in this direction, the chill shown in the accompanying cut was designed.

This chill is composed of two parts—an

external sleeve or shell fitting over a taper plug or center. The sleeve is straight on its outside diameter, and bored tapering. A slot is cut through one side of this sleeve to allow it to be easily removed from the work. The plug is made tapering to fit the sleeve, and has a spline which will fill the slot in the sleeve, making the complete chill smooth and symmetrical. On the ends of this plug are made prints, to set into corresponding depressions in the sand, as ordinary cores.

To be used with this chill, a flask is constructed having prints made in the iron in such a manner as to hold the chill perfectly true with the work when the pattern is properly made of metal. These metal prints are so arranged that the faces form surfaces against which the metal forming the hubs flows, thereby facing the hubs as well as, in effect, boring them, without machine work, making the hole and face true with the piece.

The chill is so designed that any degree of hardness may be produced.

These chills are made by Frank L. Minturn, No. 34 W. Georgia Street, Indianapolis, Ind.

Proportioning Steam Ports and Slide Valves.

Mr. C. C. Collins wishes to have the following paragraph published to further elucidate his article on the above subject, which appeared in our issue of September 27: "I call the width of steam port, unity; then make lap of valve the same and the travel of valve four times the width of port. This gives an average cut-off at ¾ stroke."

Thomas Alcorn is made master mechanic of the Hudson River division of the New York, West Shore and Buffalo Railroad, in place of Harry Linn, resigned. John Midway takes Mr. Alcorn's place as general foreman at New Durham.

Credits in Various Countries.

In answer to a circular from the Department of State the U. S. Consuls reported on the credit and trade systems of their several districts. The reports as published make a volume of 600 pages. It is interesting to observe to what extent credit prevails in most countries of the world. We make some extracts from these Consular reports.

Montreal, Canada—It is safe to say 90 per cent. of the business is done on credit.

Sherbrooke, Canada—About one-half the merchandise is sold on credits ranging from one to six months.

Prince Edward's Island—Not more than five per cent. of the dealers do a cash business.

Mexico—It is estimated that the business of the country is about equally divided between cash and credit.

Venezuela—The bulk of sales are made on four to twelve months' credit. Very few cash sales. Losses in business about ten per cent.

British Guiana—Three-quarters of sales are on credit.

Brazil—At least three-fourths of the volume of business is on credit. With a capital of $20,000 it is not unusual to be owing $100,000.

Uruguay—About 50 per cent. of the whole business is done on credit.

Argentine Republic—Cash sales are the exception.

Cuba—Almost the whole of the trade of Cuba is based on credit.

Porto Rico—At least 75 per cent. of the business is on credit.

Hayti—Seventy-five per cent. of merchandise is sold on credit.

Bradford, England—Wholesale business is almost entirely done on credit; from one to six months' time being allowed.

Newcastle-on-Tyne—Business generally is about 75 per cent. done on credit. Wholesale trade, 90 per cent. Retail trade, 50 per cent.

Cork, Ireland—Seventy per cent. of the chief trade of Cork is conducted on the credit system.

Glasgow, Scotland—When business is at its best the credit system is all but universal.

Leith, Scotland—Nearly all the wholesale business, and probably half the retail business, is done on credit.

Cardiff, Wales—Credit prevails to the extent of quite two-thirds the volume of business.

Baden, Germany—Amount of credit is large. Long credits are given; competition is great, and profits small.

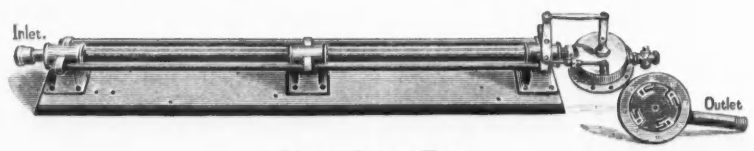
Barmen, Germany—Three-quarters to seven-eighths of the goods in wholesale trade are bought on credit.

Munich, Bavaria—Nine-tenths of all business transactions are done on a credit of from one to six months.

Crefeld, Austria—Trade and manufactures in this district are carried on almost wholly under the credit system. Usually 6 months' time is allowed.

Amsterdam, Holland—The wholesale trade is carried on more upon the cash than the credit system.

Austria—Seventy-five per cent. of the volume of business is done on credit.



Morse Steam Trap.

Madrid, Spain—About one-fifth of the business is done on credit.

Turkey—Credit prevails at least to 50 per cent. of the business.

Russia—From one-half to two-thirds of the business of the country is done on credit.

Rouen, France—Credit may be considered at three-fourths the total amount of business.

St. Gall, France—From 60 to 75 per cent. of all business is done on credit.

Venice, Italy—Credits are rather exceptional.

Portugal—Trade is mainly carried on by credits, and on many articles very long credits are given.

Lombardy, Italy—The credit system is practically universal.

Michael A. Barber, of Norwich, Conn., has obtained a patent on, he claims, a new method of truing grindstones, that will earn him the benedictions of the youngest apprentice, should the device come into general use. He places two grindstones in one frame, one of the stones being so arranged that it can be traversed laterally across the face of its mate, and suitable means are provided for bringing the face of the stones together as they get worn. One grindstone is made to grind the other true.

A correspondent calls for the assistance of machine-men's ideas on how to devise a portable machine for straightening wires ⅜ diameter.

Rev. Dr. Talmage says: "This has been the most valuable summer for ten years. The wind has been pricked from the great bubble of American speculation. Great businesses built on borrowed capital have been obliterated. There is one word that has deluded more people into bankruptcy than any other—the word "borrow." That word is responsible for all the defalcations and embezzlements of the last four months and of the last forty."

The East Tennessee, Virginia & Georgia Railroad Company, following the example of nearly all other railroad companies, determined that no trainmen should be employed who could not read and write. An order to effect this was recently enforced, and it led to dispensing with the services of all the negro train hands. Previously most of the firemen were colored men, and now there is not one left.

A correspondent wishes to know the composition of Parsons' white brass. Can any of our readers furnish the information?

Morse's Steam Trap.

In this trap the valve case is made of two circular brass plates bolted together. This case contains a plate on which are four raised valve seats, with openings for the escape of the water of condensation. A disk valve covers these seats, and is operated by the expansion and contraction of the pipe (according as steam or water is present) to which the valve case is attached, through the lever shown.

We are informed that this trap has been in use for some time, with results so satisfactory that a company, known as the Morse Steam Trap and Machine Company, Naugatuck, Conn., has commenced their manufacture.

A branch of the National Association of Stationary Engines was recently organized in Syracuse, N. Y., with 28 members. Jerome S. Moseley was elected president, Henry Comstock, vice-president; W. H. Acker, secretary; Henry Deland, treasurer; Albert Desmond, conductor, and George Hall, doorkeeper. Initiation fee is $2.

The Pennsylvania Railroad Company is increasing the standard of capacity of its coal cars to 50,000 from 40,000 pounds.

There is evidently an "overproduction" of municipal as well as of railroad bonds. Bids were recently asked for a lot of new dock bonds of New York city. They bear 3 per cent. interest, have 30 years to run, and are exempt from local taxation. On the day for opening the bids not a single bid had been received. As the credit of the city is undoubted a scarcity of money is probably the cause.

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NEW YORK, OCTOBER 11, 1884.

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Exhibitions in Progress.

The American Institute Fair is now in progress in New York City, having opened Sept. 24th. It is drawing crowds of visitors, as it does every year. In Boston two industrial exhibitions are running: that of the New England Manufacturers and Mechanics' Institute, and that of the Charitable Mechanic Society. The Southern Industrial Exhibition is in full blast in Louisville, and will remain so until October 25th. The Cincinnati Exhibition will close October 4th. The St. Louis Exposition is open, and will run until October 18th. The International Electrical Exhibition, now running in Philadelphia, will close October 11th. The Chicago Industrial Exhibition is in full operation. At all these exhibitions the machinery exhibits are the most interesting. Besides, there are several State and county fairs in progress where fat cattle, trotting horses, big pumpkins, and (occasionally) candidates for President of the United States are to be seen.

Master Mechanics' Committee Work.

The working committees of the Master Mechanics' Association have got to work in good season this year. We have already received two circulars calling for information on subjects under investigation. Mr. W. F. Turreff, General Master Mechanic of the C. C. C. & I. Railway, Cleveland, Ohio, is chairman of a committee on smoke-stacks and spark-arresters. So that a report may be framed showing in a comprehensive way what progress our railroads are making with the devices mentioned, Mr. Turreff requires each member of the Association to let him know what form of stack is used in connection with the ordinary smoke arch. What forms of spark-arresters, if any, are used in connection with the extension front end? What experience they have had with brick arch or other device in the firebox in connection with the extension port end?

Mr. N. H. Sprague, of the Porter Locomotive Works, Pittsburgh, is chairman of a committee on hydraulic boiler tests. In connection with this subject he asks the questions: Is the frequent testing of boilers by hydraulic pressure desirable? If so, how often should these tests be made? What excess over working pressure should be applied, and why? Do you recommend other tests in connection with hydraulic? If so, what other tests, and why? Do you consider the test of a locomotive boiler at rest by hydraulic pressure conclusive as to its safety under all conditions of service? Please give any information you may have on this subject not called for in the foregoing questions.

Every year complaints are repeated by the several committees that their reports are defective through want of proper co-operation of the members, the great majority paying no attention whatever to the circulars of enquiry. This is very discreditable to the members who, by careless omission, act discourteously towards the committees and do injustice to the association, which can only be kept useful by the heartily-combined labor of all the members. Members who neglect to send in answers, keep back small items of information that, when summed up, would often strikingly increase the value of a report, and supply others with useful intelligence. It often happens that a master mechanic has no new points to offer on all the questions brought up, but this should not keep him from giving notes of his experience, or making suggestions regarding other subjects. Again, a master mechanic has experimented a great deal in a particular line, and its details become very familiar to his mind. When a question comes in on this subject, he falls into the error of supposing that others are equally familiar with it, and on that supposition withholds information that would be new and useful to many of his fellow-members. On behalf of the wide interests of the Master Mechanics' Association we would urge members to devote greater attention to the circulars they receive, and relate in a brief way their experience with the devices or methods under investigation.

Reported Danger to Our Clock Trade.

It is a melancholy spectacle to witness the twistings and torturings of our free-trade friends in their struggles to enlist the attention of an unsympathizing public. The latest of their proselytizing efforts was the following dispatch telegraphed from New Haven, Conn.:

The New Haven Clock Company, it is said, and the clock factories at Winsted and Thomaston, all of which manufacture the bulk of American clocks for foreign export and employ thousands of workmen, will soon very seriously suffer from competition with Germany, because of the tariff on English steel, necessary for springs. The Germans buy this steel for much less than it can be bought here, owing to the tariff. A German clockmaker, by sending his three sons into the New Haven factory, in its various departments, a few years ago, captured all the secrets of Yankee cheap manufacture. He is now competing with them.

The enterprising free-traders who invented this news took care not to mention that the greater part of the springs for American clocks are made from native steel, and that those made from imported steel are so light that an added cost of two cents for import duty on the material is a high average. The idea of German clockmakers *capturing* the secrets of the American clock trade is simply absurd. No trade was ever carried on more openly. The whole world became familiar with the system in the centennial year, and many foreign clockmakers have been trying to utilize the knowledge then gained, but there are yet no indications of underselling us even in their own markets.

An Example of the Prison Contract System.

The rank injustice of the prison contract labor system is well illustrated in the erection of the new penitentiary at Joliet, Ill. While the wages of free, honest stone cutters are $4 to $4.50 the contractor is furnished with convict labor at 71 cents a day to cut all the stone required for the building. All the profits of this lucrative job go into his pocket, and the people are taxed to pay the bills for work done by their own criminals sentenced to hard labor, at five or six times the price the contractor pays for their labor. If the newspaper organs of the prison contract ring can figure out an advantage to the State in this transaction they may, perhaps, solve that other problem they have been wrestling with about nine months, that is, to show that the 139,000 majority that came out of the ballot boxes in the State of New York last fall *for* the proposition to abolish contract labor in prisons really meant that the contract system should be continued.

A Chicago weekly, that wears a blue overcoat and poses before the public as "an illustrated journal, scientific and practical," inserts a yellow leaf offering an "Inducement Extraordinary" to obtain subscribers. Its subscription price is $4 a year, and it offers $5 worth of books and the paper from now until January 1, 1886, for $4. The person getting up a club of five gets $10 worth of books, in addition to each of the subscribers receiving the $5 worth, as above stated. Only one thing is lacking in this offer. It is not enough to pay subscribers for taking the paper. There should be another premium to pay them for reading it.

The Battle of the Jugs.

Shall a gallon jug hold a gallon or not? That is the question now agitating the pottery manufacturers of northern Ohio. As heretofore fabricated it has not held a gallon. In a sudden spasm of reform, the pottery manufacturers decided to make all jugs and crocks full size. But here is the rub: All their workmen decided to strike unless they got paid extra for making what may be called extra size, in view of past practice. The manufacturers won't pay extra, and the battle of the jugs is fairly under way. The contest will have a wholesome effect, as it will show the people how they have been cheated in measure these many years. Why should the purchasers of crockery not get up a strike against the little jug? Let them refuse to buy it unless it holds what it is represented to hold. Then the jug question will be promptly and fairly settled.

Give Name and Address.

Questions are frequently received in this office about subjects which we do not consider of sufficient public interest to answer in our columns, and answers are sent by mail. It occasionally happens that the addresses given are so defective that the letters are returned to us with the intimation that the party cannot be found. When people writing here for information on technical subjects are so careless about their address as to make their whereabouts uncertain, they need not be surprised at failing to hear from their communications.

We have published many letters from practical men, but it is seldom we get a letter (for publication) from a practical woman. In this issue will be found a very practical letter from Miss Frances Cassey, of Oberlin, O., noting the way she made $94.45 in 22 days by replating knives, forks, spoons, castors, and other articles for the neighbors, the plating machine costing but $4. Not being selfish, she offers to send instructions for making a plating machine to any one who will forward to her some good geological specimens. Miss Cassey will, no doubt, make an interesting cabinet collection.

Buying Foreign in Preference to Home Products.

Two amusing instances of the besetting weakness of human nature for placing a fictitious value on articles of foreign manufacture were recently recorded. In one instance the representative of a wealthy English family that would use no table cutlery except that sold at a particular shop in Paris, inquiring if he could rely upon the quality being the same as that of the last purchase, was answered that the house sold nothing but the best Sheffield make. The other instance is that of a Dutchman who paid an exorbitant price for a kitchen stove, in Paris, and had it carried at a good round expense to Rotterdam. The stove required some little fixing before being put to use, and the Rotterdam manufacturer who was entrusted with the job, succeeded, by removing the attached trade mark, thereby exposing his own cast in the plate, in satisfying the purchaser that he made the stove. These are typical cases, not typical of the nationalities represented but of the idea that it is requisite to go away from home to get what is best. It is not necessary for Americans to go abroad to see the indefinite multiplication of instances equally absurd. Millions of dollars yearly find their way out of the country to pay for foreign products that could be had of home manufacture quite as cheaply, and in many instances of superior quality. Foreign trade-marks have a fascination for a good many, and they buy the trade-mark without much reference to the quality of the goods. The family of the English gentleman and the Rotterdam citizen are more than matched in this country. This—buying foreign in preference to home products—reacts upon the purchaser, making less demand for what he produces, or for his labor. Good judgment—common prudence—leads sensible people to patronize home industries whenever practicable. There are others who would be better suited by having foreign trade-marks attached to articles of home manufacture, and the price advanced one hundred per cent.

"Protection and Free Trade To-day" is the title of an address by Robert P. Porter, published in a recent pamphlet by James R. Osgood & Co., Boston. The writer takes a stand decidedly in favor of protection by America of her native industries, the reasons for such a policy not being founded on abstractions, but on the records of national

progress. Most political economists readily admit that carefully-prepared statistics furnish the best record of a nation's condition. Mr. Porter has carefully collected the statistics of nations that follow free trade policy and compared them with others that practice protection, and his pamphlet reflects the results of the investigation. The evidence favoring a protective policy appears overwhelming.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(384) J. A. B., Bangor, Me., asks: What can I use as a lacquer for brass to keep it from tarnishing. *A.*—The information can be found in the AMERICAN MACHINIST of May 12, 1883, page 9.

(385) O. C. U., Wilkesbarre, Pa., asks: Can you tell me when and where the first T rails were made? I think it is claimed they were first made in Pennsylvania. *A.*—We cannot answer this question with certainty. The credit is claimed for both Pennsylvania and New Jersey.

(386) J. H. D., Williamsport, Pa., writes: I was recently called to examine a boiler, and found that they had lost the ball, and had hung two or three car links on the lever. How shall I find the proper weight of ball in a case of that kind? *A.*—You will find this very fully explained in the AMERICAN MACHINIST of June 26, 1880.

(387) Inquirer, ——, asks: 1. What should be the width of steam and exhaust ports, they being 7″ long, width of bridges, lap and travel of valve, for a 10″x12″ engine, to cut off at ¾ stroke and to run 160 revolutions? *A.*—You can make the steam ports ⅞″ wide, exhaust port 1¾″ wide, bridges ¾″, steam lap ¾″, exhaust lap ¼″, travel of valve 3″. 2. What would be the horse-power of such an engine with 60 lbs. boiler pressure? *A.*—About twenty horse-power.

(388) C. G., Corinth, Miss., asks: 1. Please give a description of the Margach and Richardson balanced slide valves, referred to in the AMERICAN MACHINIST of July 12. *A.*—We are not acquainted with the construction of the Margach valve. You will find the Richardson valve described in the AMERICAN MACHINIST of July 16, 1881, and February 25, 1882. 2. What alterations to steam chest are necessary to apply these valves? *A.*—It is not generally necessary to make any alterations to steam chest, to apply the Richardson valve.

(389) M. S., Hartford, Conn., asks: What are the advantages and what the disadvantages of high-speed steam engines? *A.*—You will find the advantages discussed by Charles T. Porter in the AMERICAN MACHINIST of August 9, 16, and 23; September 27, October 11 and 18, November 15 and 29, and December 20, 1879; January 24, March 20, May 22, August 28, and October 2, 1880. You will also find the opposite side discussed by Charles A. Hague in the AMERICAN MACHINIST of March 4 and 25, April 1, 8, 15, and 29, 1882.

(390) W. S., Woodley, Ala., writes: In Mr. Currier's diagram, to show the action of governor, AMERICAN MACHINIST, September 20, I understand that the diagram shows the initial pressure for 25 strokes, and that the time was less than one-quarter of a minute. It seems to me, if this is so, that it would indeed be a rather lively fly-wheel for a weight of seven tons. How was the indicator attached? *A.*—The indicator was attached in the ordinary manner. One hundred revolutions per minute would not be fast for a seven-ton wheel.

(391) W. L. H., Wallula, W. T., asks: 1. What is the difference between internal grooving and internal corrosion in steam boilers? *A.*—Grooving means that the corrosion develops in grooved lines. Internal grooving is internal corrosion of that particular kind. 2. Can I run as engineer of a steam scow with a second-class engineer's license, or would it be necessary to get a special-class certificate? *A.*—The local inspector would be the best authority on the matter, but we certainly think a second-class engineer's certificate would indicate experience sufficient for running a steam scow.

(392) I. B. W., Philadelphia, Pa., asks: Will you please give me a rule to determine how much further the crank of an engine travels in an hour than the piston? *A.*—The mean speed of the crank is 1.5708 times greater than that of the piston, hence, if you find how far the piston travels in an hour, and multiply this by 1.5708, it will give you the distance traveled by the crank. Suppose the engine with a stroke of 1 foot makes 100 revolutions per minute, to find how far the crank travels in an hour: The piston will travel 2 feet at each stroke, and 2×100×60=12000 feet per hour, and the crank will travel 12000×1.5708=18849 feet per hour.

(393) G. A., Pontiac, R. I., asks: 1. What power can I get from an engine of the Brotherhood type, having three single-acting cylinders 2½″x3″, boiler pressure 100 lbs.? *A.*—From three to four horse power, at 500 revolutions. 2. How much heating surface shall I require in a coil boiler to furnish steam for the engine? *A.*—Forty feet of good heating surface should answer. 3. What size three-blade propeller should I use? *A.*—You can use a 24″ propeller. 4. What sized boat would it run? *A.*—25 feet length over all, 5½ feet beam.

(394) W. S. F., London, Ont., asks: 1. How is the polish that is used on ladies' and children's shoes made? *A.*—It is made in a variety of ways. A receipt for making it, found in most receipt books, is: Ivory black and molasses, one pound of each; ¼ pound each of sweet oil and oil of vitriol (sulphuric acid). Rub the first three together until the oil is killed, then gradually add the vitriol, diluted with three times its weight of water. Mix the whole well together, let it stand for three hours, then reduce to proper consistency by adding water or sour beer. We will further consider your second question.

BUSINESS SPECIALS

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Curtis pressure regulator and st'm trap. Sep. 20, p.16.

Mackenzie Cupolas and Blowers. 245 Broadway, N.Y.

Katzenstein metallic packing, 169 Christopher st., N Y

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Steel Name Stamps, &c J. B. Roney, Lynn, Mass.

Rotary Files, Tower M. Works, E. Brookfield, Mass.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 632 F st., Washington, D. C.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Foot Power Machinery, for workshop use, sent on trial if desired. W.F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Consulting Engineer and Mechanical expert, C. C. Hill, 84 Market street, Chicago, Ill.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

National and box chucks, foot and power lathes, and slide rests. Lodge, Barker & Co., Cincinnati, O.

Mech'l drawing and machine designing, work requiring skill and experience solicited. Reasonable rates. Corresp'nce invited. Weston & Smith, Syracuse, N.Y.

DRAWINGS — Mechanical, electrical and Patent Office. All styles of artistic designing. Special facilities. Low rates. Wallace Metcalf, 140 Nassau St., N.Y.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

The "Wax Process" Engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large: prices low. Frasse & Co, 62 Chatham St., N. Y.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

Steam users, expecting to put in a first-class engine, from 10 to 60-horse power, will find it to their interest to send to the Straight-Line Engine Company, Syracuse, N. Y., for their new catalogue.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

Useful Information for Steam Users—A 100-page pamphlet, on the care and management of the steam engine and boiler, with hints and rules for engineers and firemen. Every engineer should have this book. Send 25c. in P. O. stamps to the J. N. Mills Publishing Company, 165 Broadway, N. Y.

MANUFACTURES

A machine shop is to be built at Birmingham, Ala., by the Georgia Pacific Railroad.

Britt, Iowa, has raised a bonus of $2,000, and will have a flour mill to cost $15,000.

Marshall, Texas, wants water works, and has appointed a committee to report upon plans.

The Marshall Foundry Company have completed a machine shop and foundry in Hickory, N. C.

Mexia, Texas, wants water works, and invites capitalists to organize a company for that purpose.

The Lake Shore Tube Works, Cleveland, O., are kept busy night and day making towers for electric lights.

The Southern Machine Company, Shelbyville, Tenn., have increased their capital from $5,000 to $25,000.

The loss by the burning of the Grand Trunk car shops, at London, Ontario, September 20, will reach $500,000.

The Weir Stove Company, of Taunton, Mass., recently bought a large tract of land, and will at once enlarge its capacity.

Burnet & Co., Cincinnati, manufacturers of architectural iron work, have begun the construction of a 100x115-foot addition.

J. & W. Williams, 361 West Fifty-second street, New York, will erect a four-story brick factory, 25x56 feet, to cost $9,000.

A company has been organized in Montgomery, Ala., with $30,000 capital, to make soap and axle grease out of cotton-seed oil.

H. W. Bulkley, 149 Broadway, New York, is building a machine shop at Orange, N. J., in which to construct his injector condensers.

The Rome Cotton Factory, Rome, Ga., has shut down for the purpose of doubling the capacity of the mill, by putting in new machinery.

The Enterprise Manufacturing Company, Akron, O., will put up an addition to their factory for making small sheet-metal goods by machinery.

Charles Frank, 613 West Forty-sixth street, New York, will erect a cleaning and dyeing factory on 130th street, to be 63x94 feet, two stories high.

The Electric Light Company, of Mobile, Ala., will probably soon establish works. J. M. Sears can give particulars.—*Baltimore Manufacturers' Record.*

The Chesapeake and Ohio Railroad Company's machine shops at Paducah, Ky., are far enough advanced to give employment to 350 mechanics.

Efforts are being made to organize a stock company to build a large cotton factory on the Saluda Mill property, Columbia, S. C. This mill was lately burned.

The Porter Iron Roofing Company, 101 West Front street, Cincinnati, have a contract to roof an iron foundry at Swancott, Ala., and another (large one) at Ripon, Miss.

There is some prospect of the Lookout Rolling Mills, of Chattanooga, Tenn., being purchased by the South Tredegar Company and turned into a bolt and nut factory.

At Waco, Texas, efforts are being made to establish another large factory in that place. The enterprise is to be a cotton-mill company, with a capital stock of $100,000.

The Straight-Line Engine Company, Syracuse, N. Y., has received the order for an engine to run an electric-light plant on board the new Government cruiser Boston. It will be 55 H. P.

Fernando B. Smith, proprietor of the Patent Novelty Works, Canton, O., is putting up an additional three-story shop. He intends to add stamping, cutting, and punching presses.

A new shoe factory, 126x40 feet, five stories high, is being erected in Keene, N. H., for John Shaw 2d & Brother, of Lynn, Mass. The factory has been exempted from taxes for ten years.

George E. Boynton, of Elkton, Md., will establish, at the corner of Covington and Montgomery streets, Baltimore, a factory for making table coverings, towels, etc. Will put in fifty looms.

The Cummer Engine Company, Cleveland, Ohio, have issued a circular describing their Ballantine ice and refrigerating machinery, which is meeting with a favorable reception wherever used.

A. Schultz & Co., Baltimore, Md., manufacturers of canners' tools, have built an addition to their factory 40x100 feet, and will put in $4,000 worth of lathes and special machinery some time this fall.

The Roanoke (Va.) Machine Works have eight consolidated locomotives in course of construction, and have orders on hand for fifteen more. Their new car-wheel foundry is in successful operation.

The Chattanooga *Tradesman* says: The force of hands at the Alabama Great Southern shops in this city is being increased. Work is much heavier than for several months, and it is thought will continue indefinitely.

McCloud & Crane, Worcester, Mass., have consolidated their business with Henry Minter, in that city, for the manufacture of iron and steel set screws, hexagon, square and round-head cap screws, studs, and nuts.

It is reported that the Enterprise Cotton Mills, at Augusta, Ga., will shortly issue bonds to the amount of $150,000, in order to obtain sufficient working capital. The factory has shut down, throwing five hundred operatives out of employment.

The Duggan-Parker Hardware Manufacturing Co., St. Louis, manufacturers of refined air furnaces, malleable iron and gray iron hardware, will increase the size of their foundry and machine shops next spring. Trip hammers and moulding machines will be added.

The people of Dawn, Mo., are wide awake, and want a flouring mill to grind one hundred barrels a day. A good bonus will be offered to parties who will invest capital in the enterprise. H. Bushnell and W. A. Fisher, of that town are ready to furnish particulars.

George W. Fifield, president, Watson J. Hildreth, treasurer, and Geo. W. Fifield, Watson J. Hildreth, and Edward B. Quinn have been incorporated as the Powell Machine and Tool Company of Worcester, Mass., for the purpose of manufacturing and selling machinery and tools.

Schmitz Brothers & Co., Chicago, are adding a brass finishing department to their works. They have also taken up in connection with their regular line of work the manufacture of dies and light machinery, and have enlarged the machine shop to 45x100 feet.—*Industrial World.*

The Blevney Manufacturing Company, 56 Academy street, Newark, N. J., who have recently placed new friction clutch pulleys and shaft couplings on the market, write us: Our orders come in as fast as we are able to take care of them. Have had inquiries through your publication from Italy.

The Ohio Valley Foundry Company, Bellaire, O., will this season erect one two-story frame 60x60 feet, one one-story frame 30x20 feet, and add 10x20 feet to another two-story frame. They will also put in one 20-horse power engine, 32 feet shafting, pulleys, drill press, emery wheels, and polishing machines.

Dean Brothers' Steam Pump Works, of Indianapolis, Ind., have just put in a large pump for the water supply of the Indiana State Insane Asylum. They have also furnished the Empire Distillery, at Chicago, and the Shelbyville (Ind.) Distillery with pumps and vacuum apparatus for the new process of distilling.

The Chicago *Industrial World* says: Ground has been leased at 48 and 50 Indiana street, and a new foundry having a capacity of about one hundred tons daily will be erected. The company comprises one of our prominent machinery manufacturers, a former owner of a West Side foundry, and two others.

The Hewes & Phillips Iron Works, Newark, N. J., have taken an order for their Corliss engine, from Martin Worn, Brooklyn, N. Y., 16″x38″, also one of same size of A. A. Griffin Iron Company, Jersey City. They have just taken an order for a 36″ slotting machine, for Bridgeport Iron works, and are just finishing one of 54″ stroke for Cleveland Forge and Iron Company.

The drop forging business of J. H. Williams & Co., Brooklyn, grows steadily. The firm have now five Stiles drops, three large presses, one Bradley hammer, and other tools and machines, besides a case-hardening and annealing furnace. Their new shops, at the corner of Richards and Bowne streets, possess some admirable features, their ventilation especially being very fine. They have now on the market fourteen sizes of single-end engineer's wrenches, and are soon to bring out a line of double end.

The Colwell Iron Works, foot of West Twenty-seventh street, New York, loaded ten cars with sugar and agricultural machinery for Mexico, September 22, the cars leaving the switch at Thirty-third street and going through to Yrapuato, a station on the Mexican Central Railroad, a few miles north of the City of Mexico, a trip of 3,600 miles (the largest consignment and the longest railroad trip that has come to their knowledge), they being inspected by Mexican custom-house at El Paso and passing without breaking bulk. Mr. A. W. Colwell, manager of the works, says: "In obtaining this order we met with French and English competition, they placing the order with us, believing in the superiority of American machinery as well as the saving of time in its execution."

The West Shore Railroad has ordered a 300-horse power Cummer engine, to drive the machinery of their new shops, now being erected at Frankfort, N. Y. The Cummer Company say they feel quite elated over this order, as it comes in the wake of an order received from the Pennsylvania Railroad under similar conditions and under just such severe competition. The engine for the latter company has just been shipped to the new works in Indianapolis. The company has orders for a 170-horse power engine for the Hadley Cotton Mills, Holyoke, Mass.; a 130-horse power engine, with outfit complete, for the Upton Manufacturing Company, of Battle Creek, Mich.; and two engines, 70-horse power each, for the Citizens' Electrical Light Company, Akron, O. Cummer engines have just been started at the Louisville Exposition and St. Louis Exposition.

McMurray & Stoughton, Hartford, Conn., have issued a very complete illustrated catalogue of shafts, couplings, bearings, and the Medart wrought iron pulley, both split and solid, in a large variety of sizes. In addition to the required information to the trade, their catalogue contains valuable general information, consisting of rules for calculating speeds and sizes of pulleys, rules for determining width of belts, single or double, for transmitting a given horse-power, also a table of the horse-power that may be transmitted by single and double belts of different widths, formulæ for strength of first and second shafts, with a table of horse-power that may be safely transmitted by first shafts up to 9⅞ inches diameter, and by second shafts up to 6⅜ inches diameter, and at various speeds. The catalogue will be found well worth preserving, for the practical information it contains.

The Oneida Steam Engine and Foundry Company have on exhibition, at the St. Louis Exposition, one of the largest displays in the way of drill chucks and lathe chucks ever shown. They have five pyramids of lathe chucks and one of drill chucks, also two beautiful pedestals made especially to show their different styles of chucks. The exhibit consists of six sizes of drill chucks and ten sizes of lathe chucks, of four different styles, viz.: Westcott's scroll combination, Westcott's geared combination, Westcott's plain geared chucks, and Westcott's independent jawed chucks. This latter is a new pattern, and is well worth examination by all who prefer the independent jawed chuck The entire number of chucks shown is one hundred and fifty, the list price of which is $3,500. The exhibit is in charge of Mr. A. E. Hawley, superintendent of the Oneida Steam Engine and Foundry Company, in connection with their agents, Hill, Clarke & Co.—*Age of Steel.*

Machinists' Supplies and Iron.

NEW YORK, September 25, 1884.

A few dealers in machinists' supplies acknowledge a slight improvement in business, but the greater part complain of the dull condition of trade.

Iron—The demand for pig continues dull, but standard brands maintain their prices. We quote No. 1 X Foundry $19.50 to $20: No. 2 X $18 to $19: Grey Forge, $16 to $17.

Copper—The market for ingot copper continues dull and nominal, with the demand limited. Lake has sold in small lots for 13¼c., and other brands at 12c. to 12½c.

Lead—There has been a sharp upward movement in common pig, prices having gone as high as 3.80c. Sellers are disposed to ask more, but few sales are made above 3.75c.

Tin—Dealers' prices remain unchanged, but the market for large lots has ruled dull and weak. For jobbing lots, Banca brings 20½c; Straits and Malacca 18.30c. to 18.40c.

✲WANTED✲

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Foundry foreman. 18 years' exp., desires position. Highest references. A., BOX 10, AM. MACHINIST.

Situation wanted by mech'l draughtsman and pattern maker. Good references. K T., AM. MACHINIST.

Good machine pattern maker wants a situation. Address "Pattern Maker," Box 379, S. Norwalk, Ct.

Situation wanted, as machine pattern maker; would go anywhere. "Maker," Box 191, Auburn, Me.

A competent and reliable steam engineer wants a situation, to set up or take charge of steam engines. Good references. Address Box 8, AM. MACHINIST.

Wanted—Permanent situation, by steady, reliable American, as pattern maker. Used to all kinds of wood-work. Good reference. Address "Mechanic," Fitchburg, Mass.

Situation by first-class mechanic, to take charge of foundry. Long experience in castings for machinery of every description and management of men. Address J. T. L., this paper.

Wanted—Situation as general foreman. Twenty-five years experience on marine, stationary, pumping, and general machinery; five years in present place. First-class references. Address B. S., AM. MACHINIST.

A first-class draughtsman, of twelve years' experience in shops and draughting-rooms, on locomotive and general machinery, wishes a re-engagement. Excellent references as to ability and steadiness. Address "Valve," AM. MACHINIST.

Wanted—By a thorough practical mechanical engineer, charge of machine works. Salary $2,500 per annum. 23 years' experience in firstclass works, in designing and building steam engines, shop tools, hydraulic machinery, printing presses, with extensive practice in special and general work. Good executive ability and business habits. Unexceptionable references. Address "Volens et Potens," AM. MACH.

For Sale, Cheap—One Tabor indicator, as good as new. C. H. Brooks, Chittenango, N. Y.

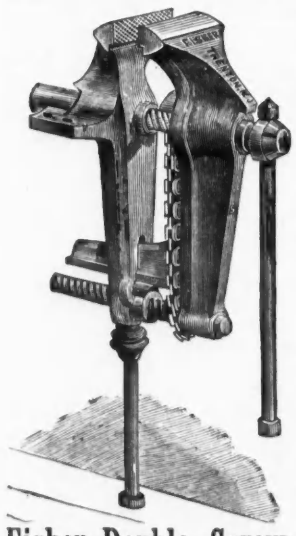
Parties having unequaled facilities for both foundry and machine work, and having the best of tools, suitable for either light or heavy work, wish to take contracts to manufacture anything in the shape of machinery or patent specialties in metal. Address "Specialties," care AM. MACHINIST.

For Sale—Half interest in demonstrated patent. No money required for manufacturing. Seller engaged in outside business. To one acquainted with steam engineering a rare opportunity is offered. Address A. B. Bowman, 800 North Second street, St Louis, Mo.

One second-hand Sellers for sale very low. **BORING and TURNING MILL**

In first-class condition, GUARANTEED.

Address P. O. Box 1078, Phila., Pa.



Largest size has 8 inch Jaw—opening 10 inches, with 26 inch Lever. Five smaller sizes, at $7 to $27. The **only** Parallel Vise that will stand heavy work. Send for circular to

EAGLE ANVIL WORKS,
TRENTON, N. J.

Fisher Double Screw Leg Vise,

WARRANTED

Stronger Grip than any other Vise.

ALWAYS PARALLEL AND CANNOT BE BROKEN

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Branch Office and Storehouse,

800 N. 2nd ST., ST. LOUIS, MO.

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FOR HARD COAL OR COKE.

INDISPENSABLE IN ALL SHOPS to keep **Bradley's Cushioned Hammers** and men fully employed, and reduce cost of production.

BRADLEY & CO., Syracuse, N. Y.

(ESTABLISHED 1832.)

FINISHED AND ROUGH PULLEYS

At greatly reduced prices to close out stock.

Send for printed list of dimensions.

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BUFFALO, N. Y.

BLUE PROCESS PAPER —HELIOS—

In Sheets and in Rolls. Prepared and Unprepared. The best article for copying Drawings.

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MATHEMATICAL INSTRUMENTS, COLORS & BRUSHES,

In largest variety. Send for Circular.

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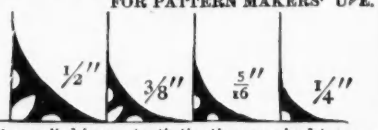
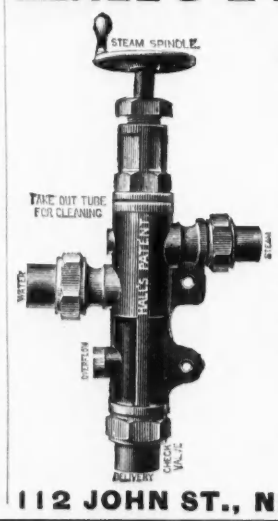
White's Flexible Metallic Fillet,

FOR PATTERN MAKERS' USE.



Can be applied in one-tenth the time required to carve curved fillets. Send for sample. H. B. Smith Machine Co., Mfrs. of Wood Working Machinery, 925 Market, Phila.

HALL'S PATENT



Automatic Injectors.

For supplying all classes of steam boilers with water. We guarantee these Injectors to be the best, simplest and only thoroughly reliable Boiler Feeders in the world, working from 2 lbs. to 200 lbs. steam pressure.

HALL'S Engineering CO.,

112 JOHN ST., NEW YORK.

The Deane Steam Pump Co., HOLYOKE, MASS.

NEW YORK. BOSTON. PHILADELPHIA. CHICAGO. ST. LOUIS.

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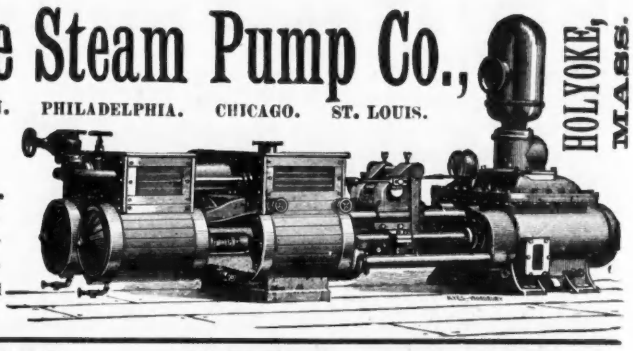
PUMPING MACHINERY

FOR ALL DUTIES.

Send for New Illustrated Catalogue.



FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS.

JAS. HUNTER & SON, North Adams, Mass.

FOR SALE

The following extra heavy machine tools:

1 8'x8'x16' Planer. Double Head with 1 interchangeable Side Head.
1 48" swing x14' Forge and Roll Turning Lathe.
1 36" " x16' " " " "
1 Double Column Universal Drill Press. Two Heads. Above Tools all new and for immediate delivery.

Hewes & Phillips Iron Works, Newark, N. J.

AUTOMATIC ENGINE.

Having patents on a **Close Regulating Independent** Cut-off Engine with **Single Valve** and **Fine Clearance**, would like to make arrangements with responsible parties for its manufacture, or will sell patents. Address

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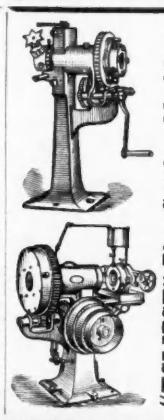

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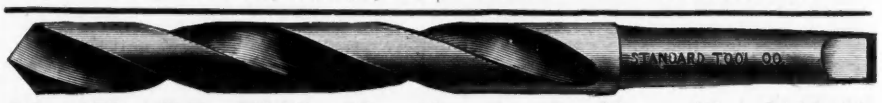

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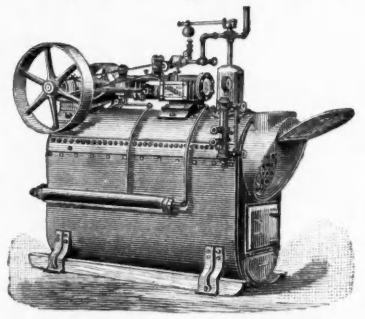

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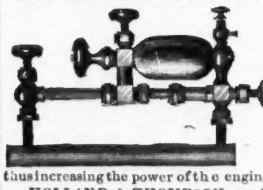

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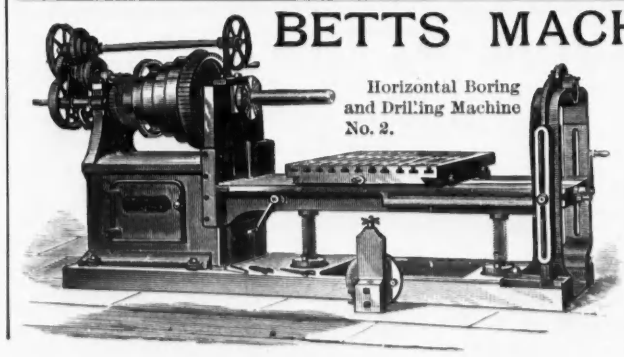

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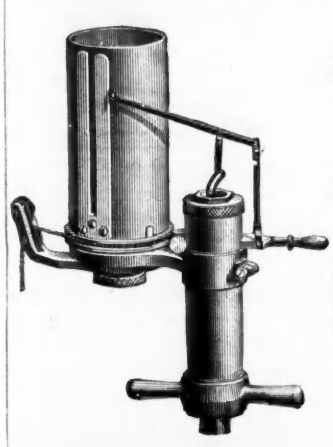

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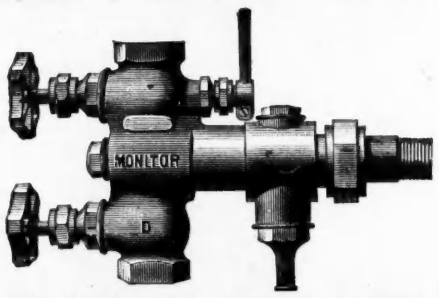

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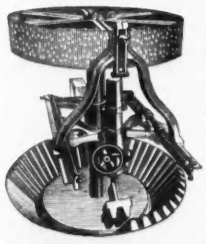

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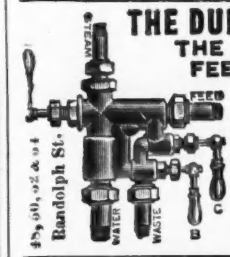

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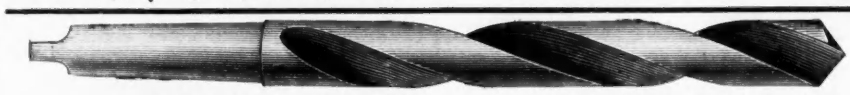

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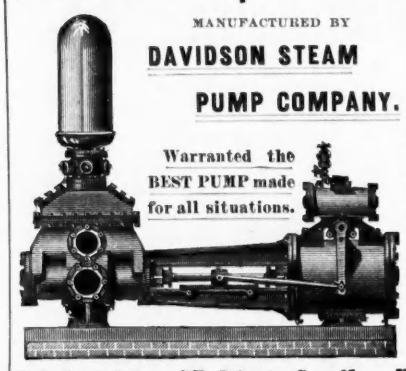

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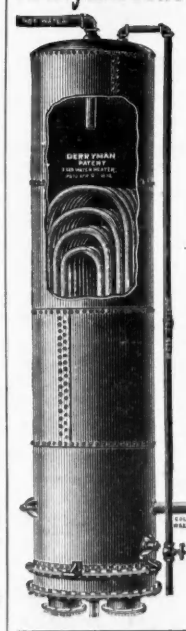

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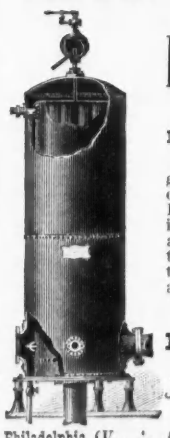

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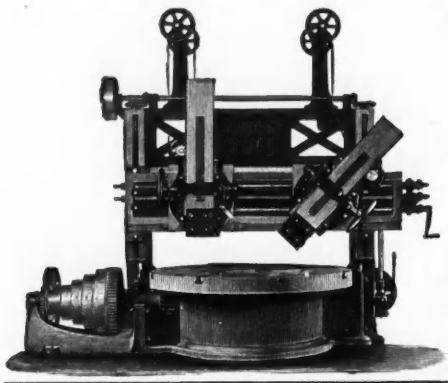

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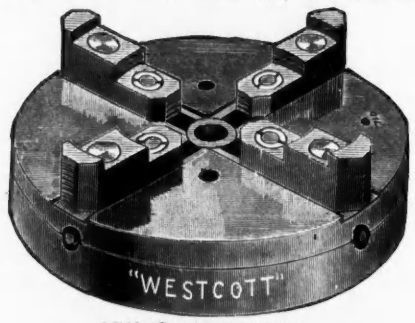

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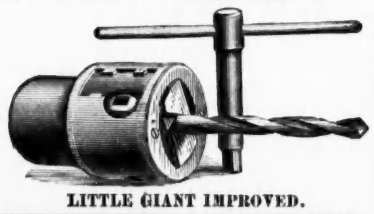

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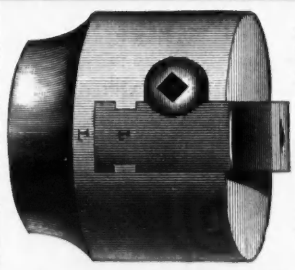

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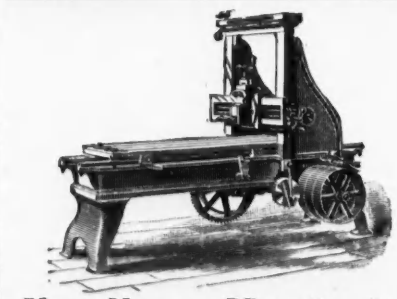

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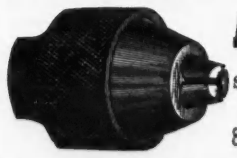

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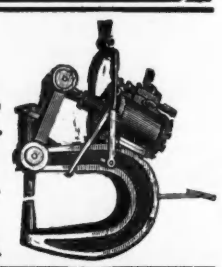

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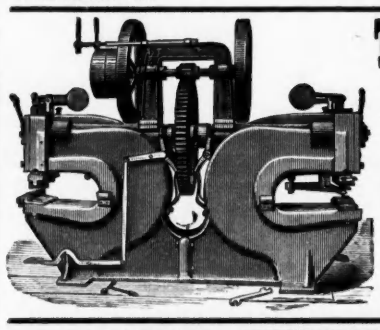

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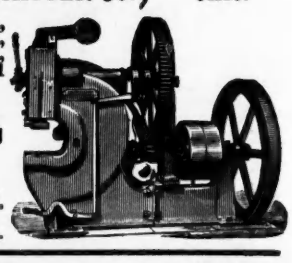

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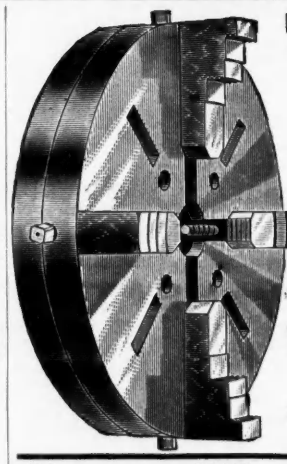

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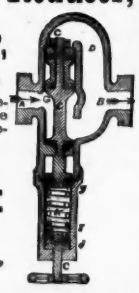

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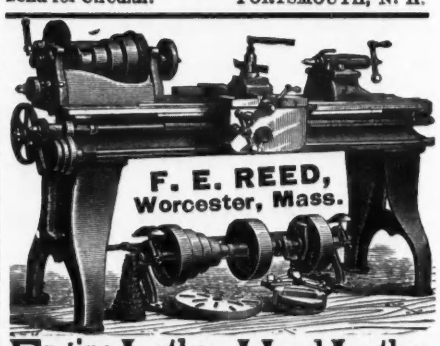

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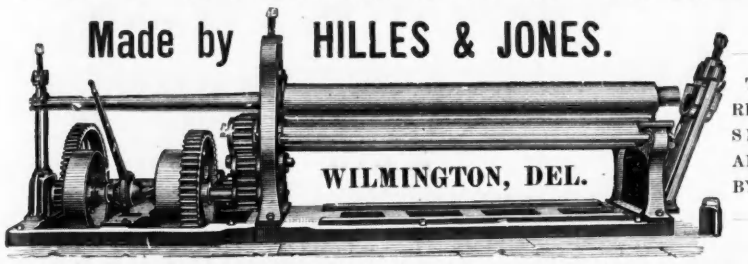

THE CUT REPRESENTS ALL SIZES THAT ARE DRIVEN BY BELTS.

It is but the work of a moment to balance the top roll and lower the hinge housing to take out the plate when a full circle is bent. The rolls are all made of solid wrought iron, the balance bar being a part or extension of the top roll. There is a cast iron bed-plate under the entire machine. To save any shifting of belts we put in Friction Pulleys, which enable the rolls to be started, stopped or reversed instantly.

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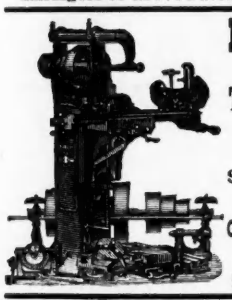

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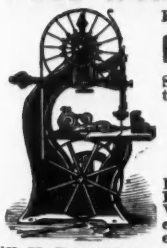

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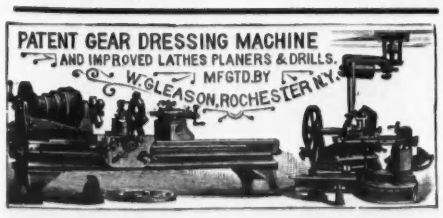

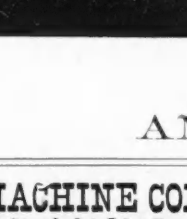

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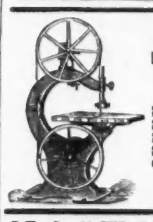

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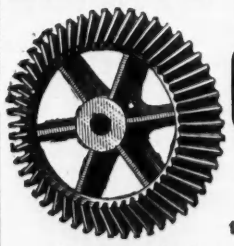

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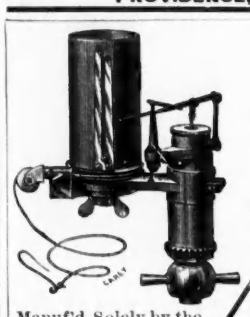

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Engineers allowed special terms.

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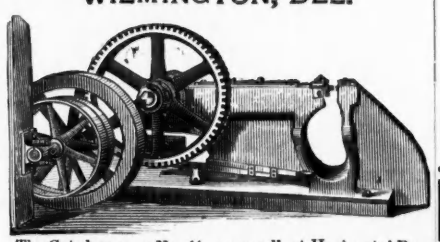

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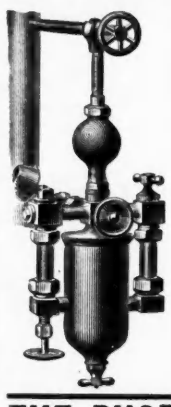

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Spring Caliper and Dividers,
FINE MACHINIST TOOLS AND FIRE ARMS.
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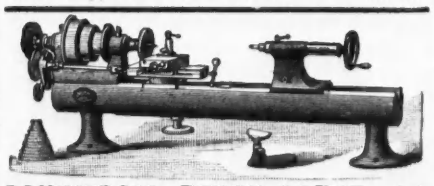

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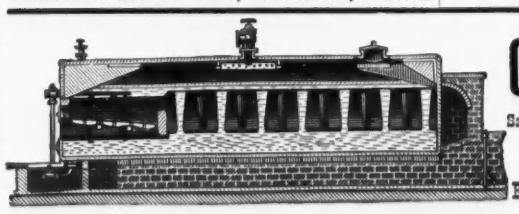

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Safety—Economy in Fuel—Low Cost of Maintenance—Dry Steam without Superheating.
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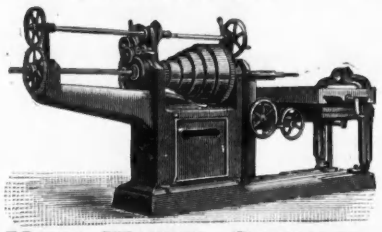

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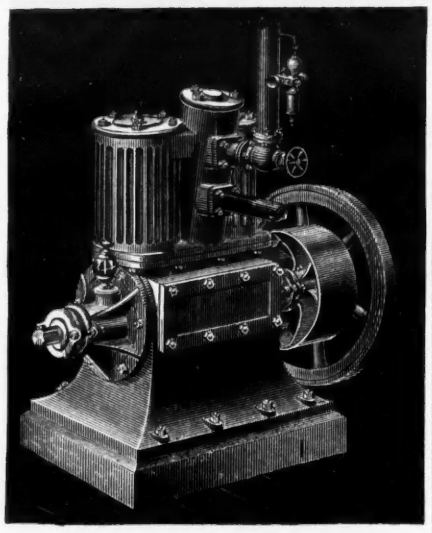

Rear view, showing one wheel removed.

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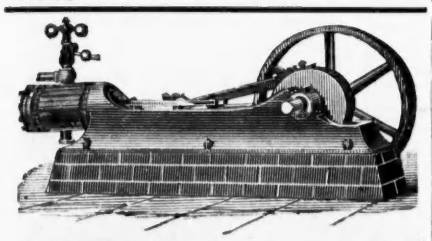

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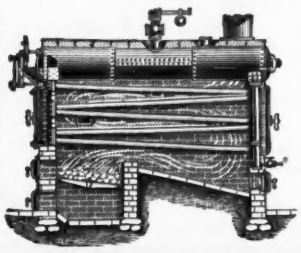

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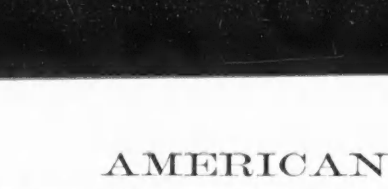

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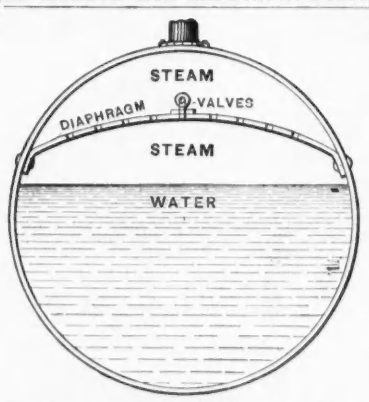

This is the only steam boiler ever devised in strict compliance with the demands of natural laws. It gives complete immunity against explosions, delivers dry steam, prevents all incrustation and deposit on the bottom plates, affords safety with high pressure, and secures great economy. The invention is applicable to every style of boiler, and can be readily applied, internally or externally, to new or old boilers. Licenses granted on liberal terms to manufacturers. Send for description.

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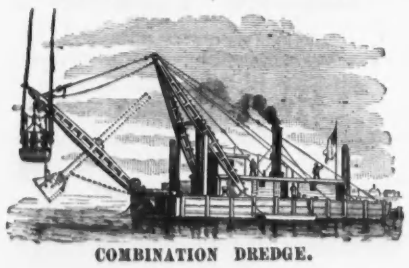
DREDGES

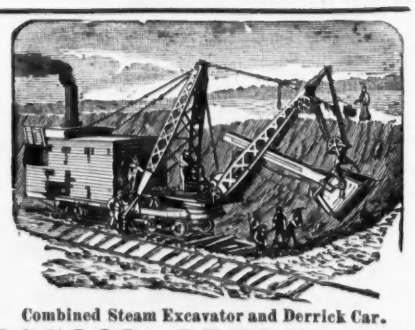
guaranteed to excavate 50 per cent. more material from hard bottom than any other machine.

EXCAVATOR

has a capacity of 6 cubic yards per minute in gravel. Very efficient and durable in the hardest hard-pan. Derrick lifts 8 tons. Circulars furnished.



COMBINATION DREDGE.



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High Speed Engines.

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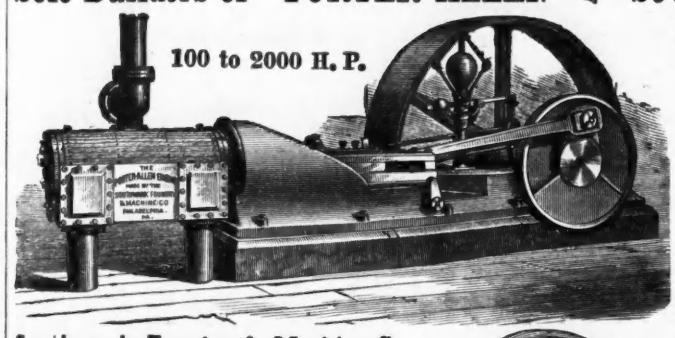

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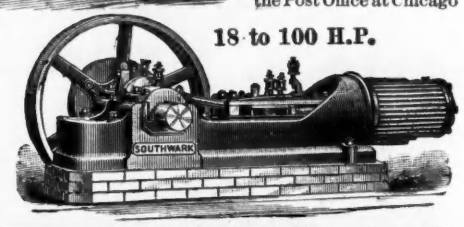

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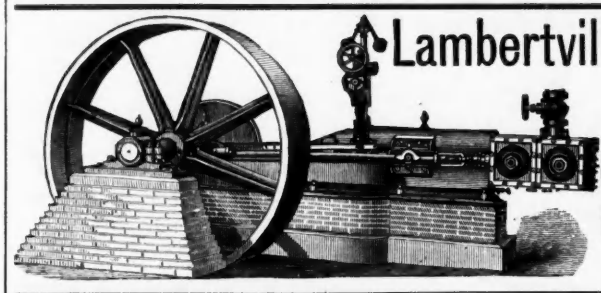

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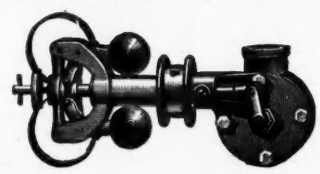

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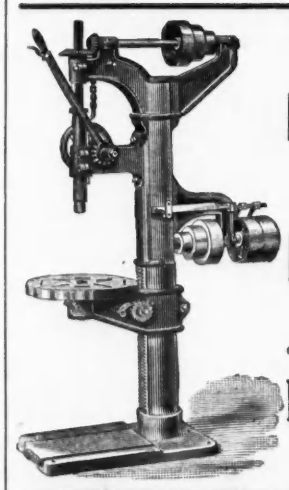

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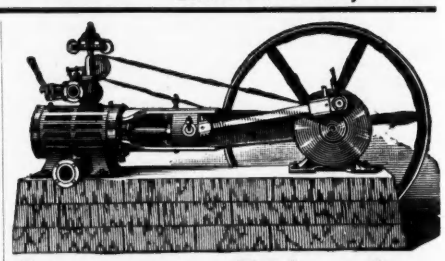

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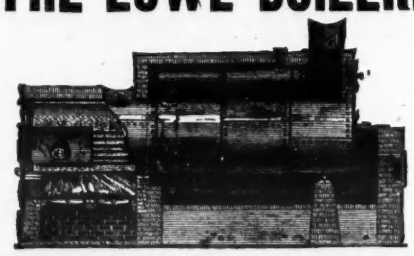

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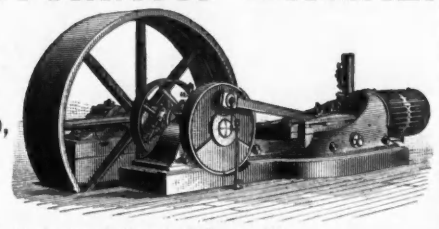

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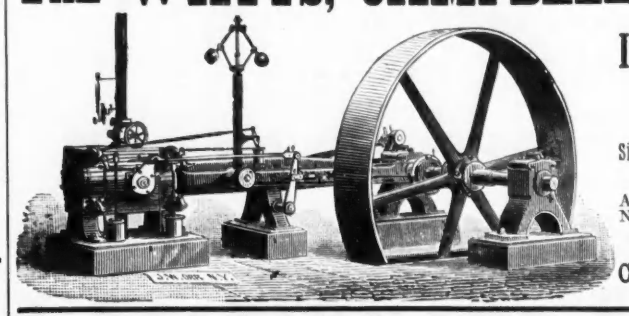

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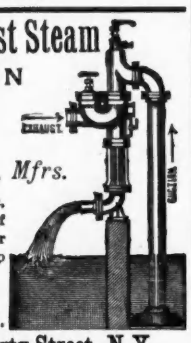

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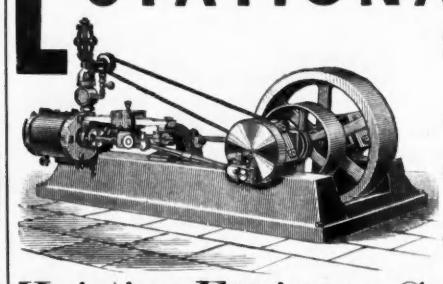

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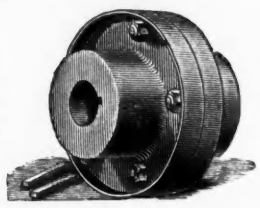

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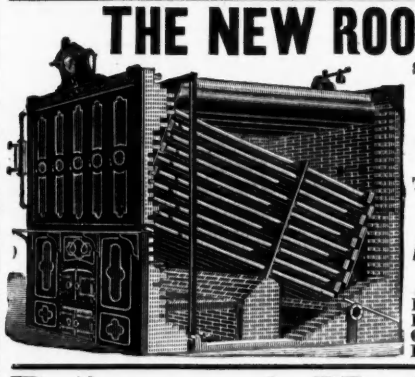

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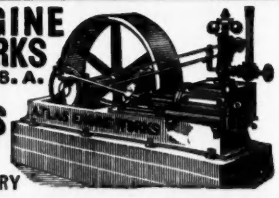

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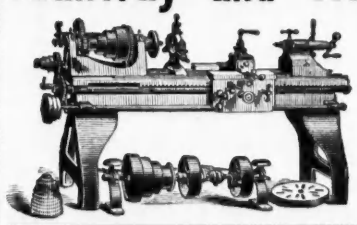

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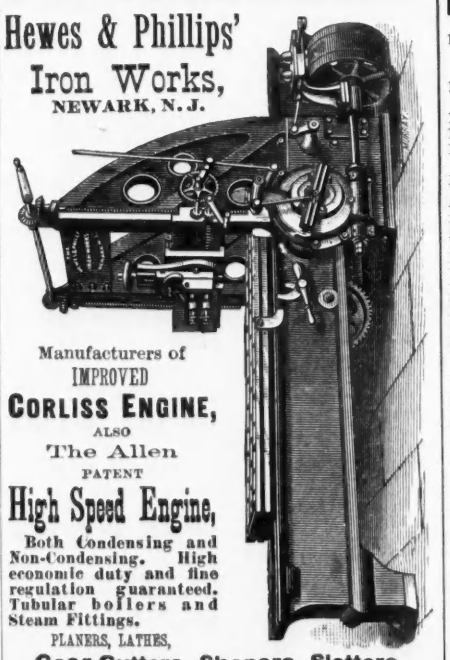

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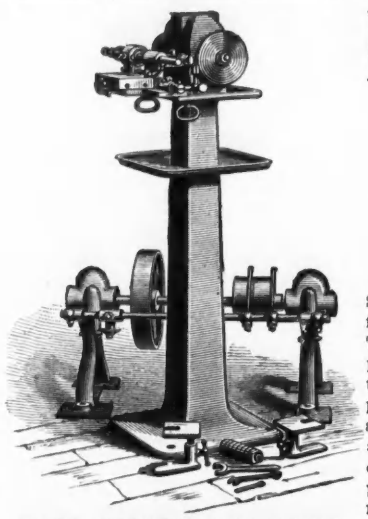

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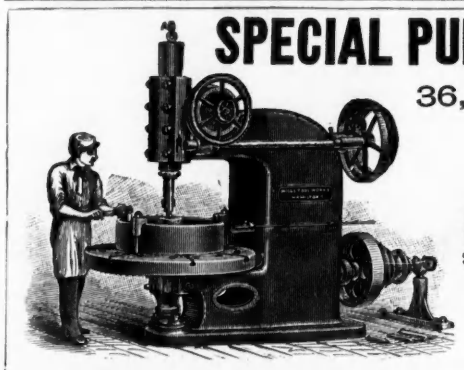

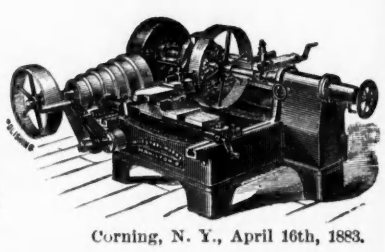

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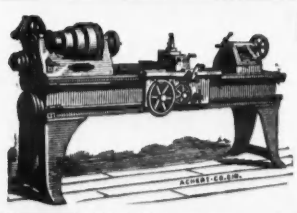

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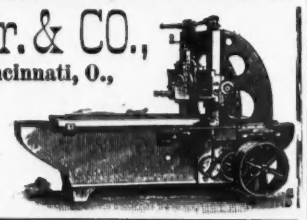

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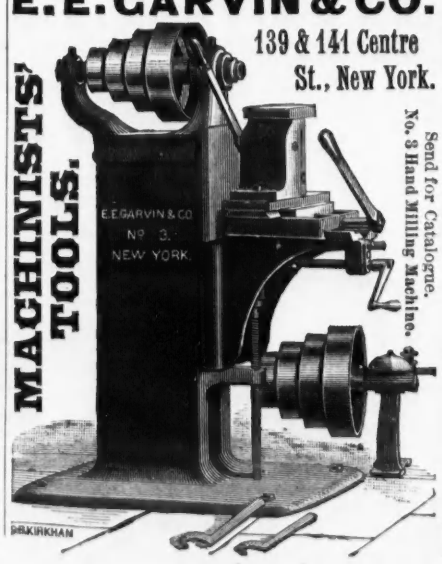

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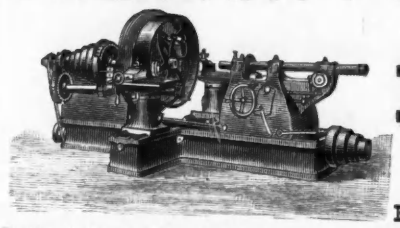

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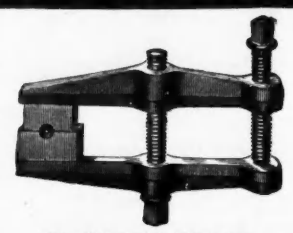

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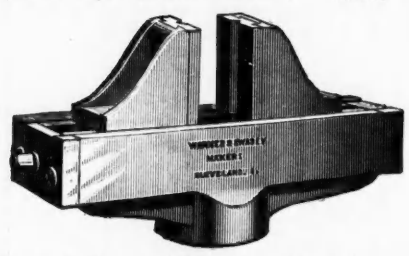

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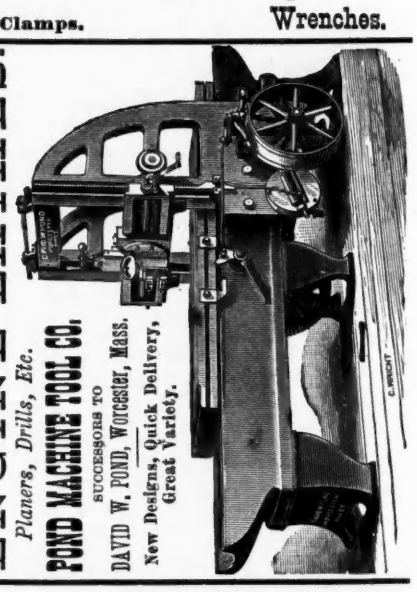

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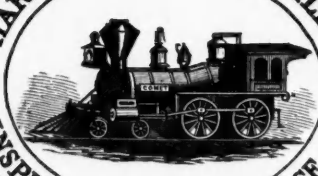

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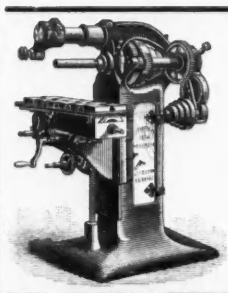

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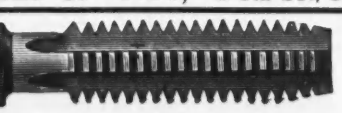

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